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Absenteeism and Labour Wastage

The Industrial Health Research Board of the Medical Research Council has published a second report,* "Hours of Work, Lost Time and Labour Wastage," which covers the period from the outbreak of war until the end of June, 1941. There is nothing either startling or revolutionary in the conclusions reached. In general there is confirmation of the principles established during the last war. Thus there is a reiteration of the well-known fact that a week much in excess of 60 hours brings about an increase in time lost progressively with the extra hours worked. It is therefore recommended that this figure be not exceeded for women employees. The collapse of France is shown to have stimulated the workers to achieve the highest production, indicating the value of well-directed, even though it be unpleasant, propaganda. The return to more reasonable hours of work, associated with staggered holidays, resulted in increased rate of production. Labour wastage, which obviously varies from factory to factory and even from shop to shop, is highest where the recruitment of untrained women has been on a large scale, for female labour, especially if married, is, as would be expected, higher than amongst men. The final conclusion is, all factors being taken into consideration, "the factory personnel deserves high praise." With these official findings few would quarrel, but it may be helpful to crystallise the views of some prominent foundry managers and foremen with whom we have discussed the problems of absence without permission. It should be understood initially that this phase of absenteeism is incapable of being studied statistically, as interpretation varies from factory to factory. Dodging overtime and persistent bad time-keeping logically enter into the classification of absent without permission. The general visualisation is, however, the taking off of a whole day for some purpose other than illness or injury, and it is with this phase that we propose to deal. This irresponsibility is less prevalent amongst the workmen who have been long employed in the same foundry than with the newcomers. The following factors have been cited as the cause: (1) Well-filled pay envelopes associated with an insufficient appreciation of elementary arithmetic; (2) the inability to spend money outside current working hours; (3) the present security of continuous employment. Into the first category enters the vexed question of income tax, for apparently the British working man is acquiring the same detestation of it, which the managerial class has had for years! Yet the latter has cheered itself somewhat with the observation that it would like to pay the same as the members of the directorate. Propaganda is necessary to achieve the correct perspective. The second factor relates to the type who for the first time finds himself with loose cash in excess of that required for normal household and personal needs and has a burning desire to spend it. Here again propaganda designed to impress it upon him that he will get better value by waiting until after the war should be worth while not only from the angle of reducing lost time, but also to increase national savings. Our only observation upon the third factor is that the tribunals which consider complaints of absence without leave must have the national needs uppermost in their minds. It is perhaps natural that we should have hinted that resort be had to propaganda in each case. As an ameliorative at least it appears to be successful in Russia, and increasing use of it is being made in the American factories. The cure suggested by a North of England foundry manager is the payment of an attendance bonus. This, however, does not appeal to us, as the Report we have cited shows that for many the prospect of earning two days' pay by working on Sunday is not universally attractive. Even if granted, there are still drawbacks, some of which may react adversely.

To return to the Report, it should be noted that the survey finished last June. Since then many conditions have changed. There has been a considerable increase in the canteen facilities at the works. Transport facilities have been, in many cases, improved. Interference by enemy action has been of a negligible character, and the entrants to industry are settling down to factory life. The compilation of statistics takes time and the next Report will, we would hazard, if it covers the present period, make a very different showing, for we envisage a decided improvement due to the "settling down" of the newcomers to factory life, and the habit of paying income tax.

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Correspondence

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

Cleaning Bronze Statuettes

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—I would suggest that, if "Girl Guide's" bronze statuette is coated with a green deposit (patina), a light scrubbing is all she should do. This patina is most valued by *connoisseurs*, taking years to accumulate naturally, and enhancing the beauty of modelling.

If the surface is already spoiled, then the method of cleaning is to swab with sulphuric acid, leave for about one minute, wash in water, scrub with water and sand, wash again, and dry very quickly, preferably in dry sawdust.

If "Girl Guide" cares to write to me, I should be pleased to answer any further questions.—Yours, etc.,

"FORTY YEARS OF STATUES."

Moulding Problems in the Electric Steel Foundry

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—In your issue of January 22, you publish the comments of your correspondent "Jeff" on "Moulding Sheaves," which appeared in the above-mentioned Paper.* I should like to point out, however, that the boss for the 6-ft. sheave would be cast 3 hrs. after the rim. No special merit is claimed for the tackle shown in Fig. 4 of the Paper. The prods are used

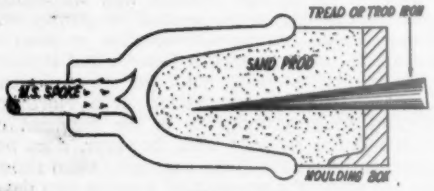


FIG. A.

loosely, the holes being arranged 6 in. apart in the box to receive them. They are positioned and secured as required, and as shown in Fig. A. A useful feature is that the prods are easily withdrawn after the rim has been cast, thereby assisting contraction.

No real difficulty is experienced with the varying depths of treads required. Provision is made by arranging the joint to suit the narrower type of tread.

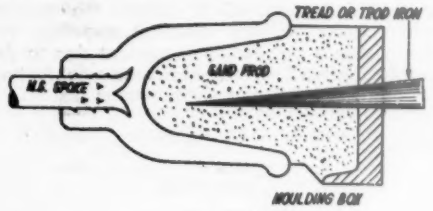


FIG. B.

As shown in Fig. B, the segment packing pieces arranged on the box joints may usefully be employed for those of a deeper nature. The spokes, as shown in Fig. 4, may appear near the mould face, but assurance is given that sufficient metal is allowed for, and no difficulty experienced in the manner suggested.—Yours, etc.,

E. J. KELLY.

Pontypridd.
February 5, 1942.

* "Foundry Trade Journal," January 1, 1942.

Some Jobbing Foundry Experiences—XXXIII

By "TRAMP"

The production of a casting off an old one has often to be undertaken in jobbing work because of the expense of patterns. The following notes describe a method of reproducing a cored casting such as is shown in Fig. 1, with the minimum of patternwork. Two suitable moulding boxes are obtained with well-fitting pins and the bottom half of the casting "bedded in" to the joint line, exceptional care being taken to joint exactly on the centre line. The top box is rammed and the casting withdrawn from the mould. This is then cleaned off and sand is removed at the outlets of the core to form the necessary core seats. Slabs of clay of a thickness equal to the required metal thickness are prepared in a frame of about 12 in. by 18 in., and pieces are cut from these

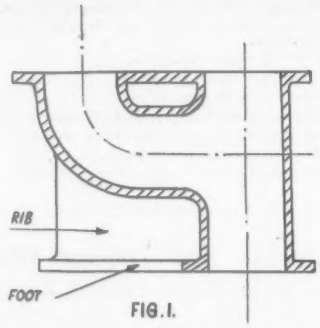


FIG. 1.

and laid in the mould, thus forming a corebox. Should the metal thickness vary—as, for example, at enlarged places if the job had screwed ends instead of flanges—slabs of a different thickness have to be used to get the correct metal thickness. This improvised corebox is lined with paper, and, suitable grids having been previously prepared, two half cores are made. The cores are lifted out, the clay removed and the mould cleaned off preparatory to receiving the cores for final closing and casting. Castings of even more complicated form than the illustration can be successfully made by this method with the minimum expense for patterns.

Foundry Query

Cupola Practice

In our cupola, which is 30 in. dia., we experience considerable trouble with the firebricks opposite the charging door which are being continually worn and broken by charging metal. We understand that some firms use cast-iron bricks on this portion of the cupola, and, if possible, we should appreciate if you would let us have some information on the subject. We would be glad to know:—(1) If cast iron is superior to firebrick for this purpose; (2) are the cast-iron bricks hollow, and, if so, what thickness of metal is used? (3) how are the cast-iron bricks bonded? (are they made so that they interlock, *i.e.*, a projection on the top brick fitting into a recess in the bottom brick?); (4) does the expansion and contraction cause any difficulty in using cast-iron bricks?

Perhaps you could let us have some light on these points at your convenience.

BELFAST FOUNDRY OWNER.

[We have suggested that (1) the cupola is on the small size to warrant C.I. bricks; (2) the factor of height of charging door from hearth is important in this connection, and, pending more expert views, more careful charging is suggested.—EDITOR.]

Random Shots

A curious coincidence has arisen which demonstrates very well a point emphasised in a recent leader, in which a plea was put forward for a closer co-operation between people of similar interests living near to one another. It appears that the "Girl Guide" (who wrote last week asking how to clean a model of Siva found in the Thames) lives only a few streets away from the Editor. This letter was answered by a retired manager of an art castings foundry, with a vast experience of such matters. Herein lies the coincidence, for this expert gave an address in the very same suburb, and the foundry of which he was manager is situated not ten minutes' walk away from where the statue was found. One might be tempted to think that this particular Siva was an apprentice's waster thrown away into the nearest sheet of water, which happened to be the Thames, but there is an assurance from the manager himself that it was genuinely of Indian origin. It is hardly necessary to add, by the way, that a very pleasant Saturday afternoon was spent by the Editor and the Girl Guide at the expert's home looking at and discussing his many treasures.

* * *

Many links with the past are disappearing simultaneously with the cast-iron railings which are being taken away for scrap. It is especially unfortunate that often this iron work is the only remaining evidence of the existence of the foundries which produced it; as in the case of the railings round St. Paul's, the ironworks in Sussex which made them having long since disappeared. So it happens that in a district with which "Marksman" is well acquainted, the railings which are being removed from the cemetery, were the work of a local founder, whose best work was done at the end of the last century before mass production became the order of the day. They are good solid castings, made by a manufacturer thinking only of permanence, not foreseeing a time when railings erected to *protect* the dead from disturbance would be torn down to make the wherewithal for *causing* disturbances, and of the sort calculated to fill cemeteries, to boot. People who have long lived in the neighbourhood remember the proprietor himself assembling his own handiwork with the help of one assistant. His foundry apparently went out of business through lack of a family successor, and the building is to-day an antique shop.

* * *

The general disgust which the typist experienced when she discovered that it was necessary in future to give up coupons for dates is now nicely counterbalanced by the joy with which her schoolboy brother hails the soap rationing scheme. At last he has found a legitimate excuse for not washing his neck and ears.

* * *

The neatest crossword clue of the week comes from "The Times":—

Clue: To resolve is the making of him.
Answer: Roosevelt.

"MARKSMAN."

Desulphurising with Acid Slags

Desulphurising experiments by R. DURRER, H. HELLBRÜGGE and B. MARINCEK, described in "Archiv für Eisenhüttenwesen," using pig-iron with acid slags in a graphite crucible, indicate that at high temperatures the pig-iron is almost wholly desulphurised, and that the sulphur is liberated as gaseous Si sulphide compounds. It is principally the silica of the slag and the silicon in the iron which are responsible for desulphurisation through the gas phase. The sulphur in the iron does not pass into the slag, which remains low in S, but escapes as gaseous silicon monosulphide, SiS.

The Wet Process of Core Removal, Casting Cleaning, and Sand Reclamation*

EVOLUTION OF THE HYDRO-BLAST SYSTEM

Removing sand, particularly core sand, by water pressure from grey iron and steel castings has been tempting to the American foundrymen for more than twenty years. The General Electric Company put in a castings washing plant at Erie, Penn., before 1920. It was, in general, an adaptation of hydraulic mining. Several hundred gallons of water per minute were discharged from a nozzle mounted on a fixed support and ejected at a pressure of between 300 and 400 lbs. Frequently, the castings themselves were put on a turntable, so that various sides could be cleaned conveniently. The gaggers were, in general, caught by a grating, and the water and sand resulting from the operation led into a succession of settling tanks, the first of which collected the coarser material, and the final one of the succession of three or four, containing, in theory, very small amounts of solids. This system has proved satisfactory where the cores are relatively soft and are easily accessible. A centrifugal pump, usually of three stages, is in general use for providing the water pressure.

It is obvious that a nozzle mounted in the wall of a large cleaning cabinet cannot reach into undercut cores. In this type of water cleaning method, also, it has been found necessary to put roofs over the cleaning room, which can be drawn back to facilitate the loading of large castings directly by crane. The roof is necessary for several reasons, the most important of which is that the large amounts of water thrown against the cores cause large pieces of core material and the gaggers to be thrown violently against the walls of the room, and might easily throw them over the walls if they were not roofed in.

The sand collected in the settling tanks is generally disposed of by taking the covers from the tops of the tanks and getting out the sand by a grab bucket, and the more or less dirty water re-used in the pump.

At the Allis-Chalmers Company, Milwaukee (which is the classical plant of this type, though not the earliest), approximately 50 tons of sand are disposed of each day by this method. Smaller castings are put in baskets, and put on a turntable for core removal. There are, to personal knowledge, only two steel foundries which use this low pressure system, and perhaps more than a dozen grey iron foundries making open work.

The chief criticism of the plant is a high first cost, and that complicated castings cannot be treated satisfactorily by this method.

FIG. 1.—A TYPICAL HYDRO-BLAST OPERATING ROOM.

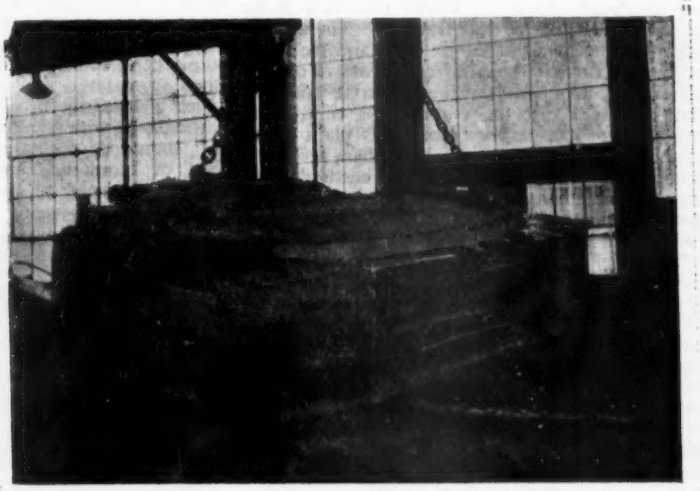


FIG. 2.—CASTING AS REMOVED FROM THE MOULDING BOX.

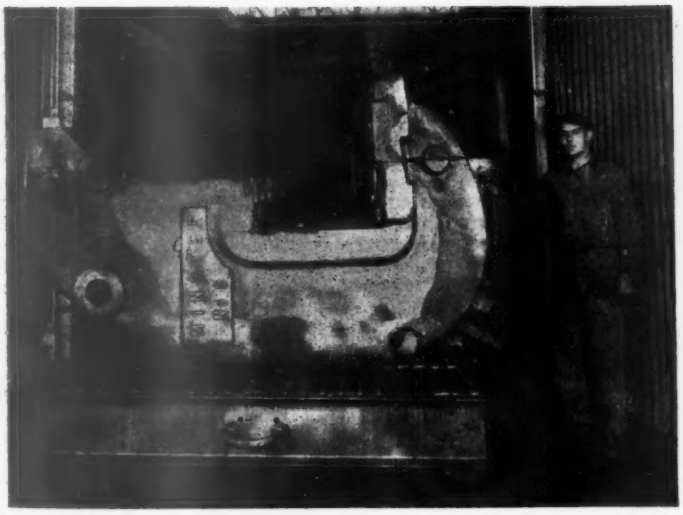


FIG. 3.—THE CASTING SHOWN IN FIG. 2, TWENTY MINUTES LATER, AFTER HYDRO-BLASTING.

FIG. 4.—A 20-TON OIL ENGINE CASTING WHICH REQUIRED 116 HRS. TO CLEAN, BUT IS NOW FETTLED BY THE HYDRO-BLAST SYSTEM IN 16 MAN-HRS.

A German Attempt

A second type of approach to the problem was made by the Badische Maschinenfabrik A.-G., of Durlach, where a high pressure pump ejected relatively small quantities of water at about 1,200 lbs. per sq. in., through a long nozzle mounted in the wall of the cleaning room, and operated from the outside. This elongated nozzle or lance was operated in a gimbal, which permitted a limited movement from the edge of the wall in a clockwise or anti-clockwise direction, and which might be advanced or withdrawn in order to bring the high pressure jet nearer to the core.

* A paper read before the Birmingham, Coventry and West Midland Branch of the Institute of British Foundrymen, Mr. N. C. Blythe presiding.

Hydro-Blast System

One of their reported difficulties was that they attempted to re-use water through the high-pressure pump in a continuous circulating system. Pump maintenance was, of course, extremely high. Relatively large savings in labour hours were reported. The author has seen no record of any further plants of this design going in.

An Unfortunate Failure

An ambitious attempt at water cleaning and water washing of sand by the low-pressure system was attempted near St. Louis by a large steel company, in which nozzles were mounted on overhead cranes to knock out very large cores on locomotive bed frames. These castings were up to 80 ft. long. The sand from the cores was carried by spiral conveyors to a rake classifier to eliminate the fine material, and was then passed on to continuous centrifugal machines of the basket type. This plant operated for about two years, and has probably done more dis-service to the wet casting-cleaning method than any other attempt, because the process was discontinued as being unsatisfactory.

The chief fault in this installation was not in the knocking out of cores, but in the handling of wet abrasive material. No accurate control of grain sizes of sand could be maintained. The centrifugal machines had a very high maintenance cost, and, unless they were continually serviced, failed to dry the sand to a moisture content desirable in the foundry. In theory, a centrifugal machine capable of continuous discharge rather than batch discharge, would be ideal for this service, but, so far as the centrifuge has been developed in America, the engineering, metallurgical and mechanical difficulties have been too great.

The Hydro-Blast System

Six or seven years intervened between these attempts, and the concept of the hydro-blast system (water sand-blasting) as now presented. The particular interest, from an engineering aspect, of the present hydro-blast system, is that this wet sand-blasting method sucks sand at a rather low velocity into a small gun, and ejects it in a very limited space of about 4 in. through a replaceable nozzle, at a velocity of approximately 20,000 ft. per min. In the original development, a rubber compound was used for the nozzle. It was found that, where velocities exceeded 12,000 ft. per min., or pressures were in excess of 800 lbs., no rubber compound was economically possible. It was found, for example, that, although water at the rate of 25 imperial gallons per minute was passing through a rubber nozzle, the impulses of the high-pressure water over a wide range of frequency created a hysteresis in the internal sections of the rubber liner, which caused it to melt. At 1,200 lbs. pressure, even with slow impulses on a high water pressure line, the rubber liner would melt within 20 secs., and vulcanise itself to the brass or stainless-steel bushing which contained it.

In current practice a tungsten carbide liner, cast centrifugally, is used, and this will last, under most abrasives, between 250 and 800 hrs. On the basis of 250 hrs., the cost in the replacement nozzles is about 5 cents (say 3d.) per hr.

The above figures were arrived at indirectly by volumetric computation, and represent the speed at which the actual volumes of sand and water must go in order to be ejected from the guns. In the gun itself, the initial orifice is a little less than one-fifth of an inch. Using 25 galls. per min. at a pressure of 1,200 lbs. per sq. in., the back pressure of the gun is between 30 and 35 lbs. The sand running through this gun amounts to between 70 and 80 lbs. per min. This sand, as well as the sand removed from the cores, falls through a grating, is washed across a vibrating screen to eliminate the oversize, and the good sand together with all of the fine material is then pumped to an elutriator or classifier, in which an upward flow of water carries the fine material over a lip with the excess water, and permits the coarser material to drop through the bottom into a sand collecting tank, which serves as a source of abrasive, the excess of which overflows into some kind of de-watering or drying equipment, and may then be used for cores.

Sand Recovery Process

The principal advantages of such a system are that a very dirty operation is performed without making any dust; one man may do the work of five or six; the sand may be recovered in a washed and graded condition, and generally fit for cores and facing in proportions up to 90 per cent. of the sand now going to the dump. Bonding material is washed out by this process, which necessarily involves re-bonding, and fits particularly with synthetic sand methods.

It should be reiterated at this point that core sand or moulding sand when it is primarily silica is returned to the foundry as core sand

FIG. 5.—THE HYDRO-BLAST GUN BEING DIRECTED UPWARDS IN A MILWAUKEE STEELFOUNDRY.

or facing material. It may also be used to replace the use of new silica sand where practice requires such a condition for increasing permeability in the backing-up sand.

Bonding material, which is a pre-occupation of the foundrymen using synthetic sand, is really not a question of importance, because whatever bond value there may be in sand which goes to the dump is, of course, wasted as well as the sand. In one American steel foundry the company has knocked out an average of 4,000 tons of steel castings per month over a period of about 4 years; has washed, classified, and dried at the rate of 15 tons of sand per hr. in a continuous system; and at a cost per ton of sand, delivered to storage bins directly over the sand mixing machines, of less than 4s., as against a previous cost of new sand of almost 20s.

It may be pointed out that the wasting of sand will cost, under the best conditions, at least 1s. per short ton, and that in congested areas this may reach up to 4s. The silica sand may be washed, classified as to grain size and distribution, and dried, for less than the latter amount.

Surface Effect

The physical effect of water sand-blasting, as far as surface cleaning goes, is quite different from that obtained by either a shot-throwing machine or by air-borne shot. The effect is abrasive rather than cutting; the surface finish is much smoother; the water and sand stream has a searching effect, and will sometimes reveal defects which would not be observable if the casting were shot-blasted.

The process will not remove spots of penetration unless an uneconomical time is spent on the work. It is, however, practicable to clean metal surfaces, quite aside from knocking out cores, to a surgical cleanliness. In two instances in America these plants are being used to surface clean the interior of castings which cannot be made clean enough by any other method. One of the results of this type of casting cleaning is a great saving in machine-cutting tools. There are many instances where a tungsten or tantalum carbide tool runs into a grain of sand lying on the surface of a casting, which blunts the tool end, requiring a take-down of the machine, regrinding of the tool and re-setting of it in relation to the casting surface.

From American experience, tool life is very much increased by a use of this water sand-blast process. It is not to be unduly stressed, but it is worthy of consideration. The effect has been particularly noticed in the softer metals, where the embedment of abrasive cuts down machine tool life. It will probably be practicable also, in certain types of work, to eliminate a pickling process now required in the specifications for certain anti-aircraft gear housings, bushing, etc.

Dust Eliminated

The presence of dust is always disagreeable to foundrymen, because of its effect on both men and machines. A long series of studies has been made on dust removal by water. It has been found, in sampling air for its dust count, that a velocity of impingement as between minute dust particles and water, of at least 12,000 ft. per min. is necessary. Where lower velocities are used, the water will not wet out the minute particles, because it does not overcome the effect of surface tension. It is, therefore, believed at the moment that low-pressure water systems do not actually prevent the diffusion of the very fine air-borne dust, which is the principal medical worry of factory inspectors. It is probable that the pneumokonioses are attributable to silica in sizes below 15 microns. This Paper is necessarily very general. Any of the assertions may be challenged. Detailed data are available in Great Britain to bear out these statements through application to the proper authorities.

In conclusion, the author is particularly desirous of thanking the Institute and the Cast Iron Research Association for affording an opportunity of addressing a gathering of British foundrymen.

REPORT OF MEETING

In opening the meeting, MR. N. C. BLYTHE, the Branch-President, said the members were pleased to welcome so distinguished an American industrialist as their guest to-day. Mr. Ronald Webster was a pioneer in the development of the water and sand method of cleaning castings. He was visiting this country as a guest of one of the Ministries to ascertain whether the system would prove useful in the solution of a problem connected with armaments.

MR. RONALD WEBSTER, before giving his talk, which was illustrated by lantern slides, said he brought greetings from the American Foundrymen's Association—a body which was deeply appreciative of the efforts the Institute was making to maintain the high standard of British technology.

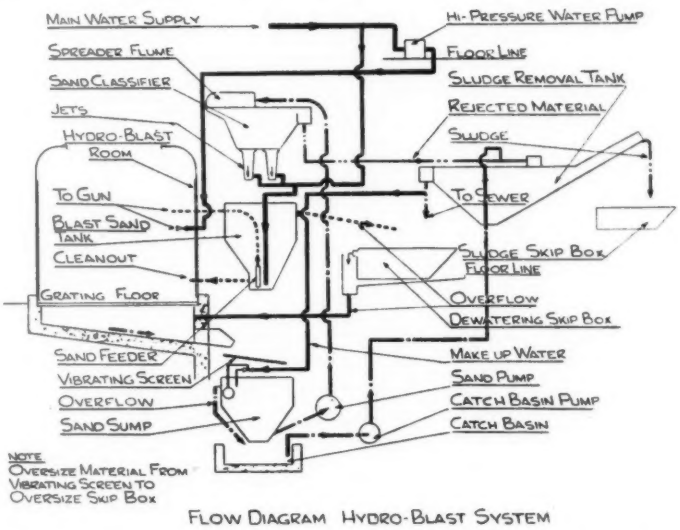
MR. BLYTHE, in calling upon Mr. Webster to give his lecture, asked him to thank the American Foundrymen's Association and on his return to reciprocate the sentiments expressed.

Hydro-Blast System

Vote of Thanks

MR. J. G. PEARCE (Director and Secretary of the British Cast Iron Research Association) proposed a vote of thanks to Mr. Webster, coupling with it an expression of satisfaction at the solidarity existing at this juncture "with our American friends." He said that it was three or four years ago since, in Chicago, he learnt something about the development which Mr. Webster had described. It had not then reached the stage of sand reclamation. While an installation for a given foundry could be discussed on a purely economic basis, the whole subject had been approached in a commendably scientific manner. There were other aspects which could not be judged on purely economic grounds. No one who visited a fettling shop could fail to be impressed with the desirability of dustless working from the point of view of the men working on the job. At present the industry was also faced with special aspects of the whole problem—the difficulty of transporting sand, both new and discarded sand; the problem of finding space in which to dump the discard, and so on. With that in mind, they in the Cast Iron Research Association had experimented with methods of reclaiming core sand, both dry and wet methods. He thought that anyone who had met Mr. Webster would pay tribute to his wide knowledge of this matter, and to his keen technical and scientific interest in it.

MR. T. H. GAMESON seconded the vote of thanks, which was accorded with applause.



FLOW DIAGRAM HYDRO-BLAST SYSTEM

DISCUSSION

Opening the discussion, MR. F. J. COOK (past-President of the Institute) exhibited a slide of a very large casting, and asked whether the method of core cleaning described would be applicable to that particular instance. It seemed to him, he said, that in the case of a job of that kind, the process would have certain disadvantages in relation to the reclamation of the sand.

In reply, MR. WEBSTER said that at a foundry he visited recently the core material was put on lorries, hauled out into the yard, riddled to get rid of the iron and then the sand, after being piled more or less mountain high, was removed either by a contractor, or in desperation was taken to a dump. The theory he acted on was that sand removal, as the cores were knocked out, must be continuous; that a convenient separation must be made of the iron and the brick bats, and that in many cases the saving involved would more than pay for the operation. He added that with one of the guns a man could do about what seven men did with pneumatic tools in knocking out internal cores. In every case where the plant had been put in the available floor space was increased.

Vision Maintenance

MR. EVERARD said those with experience of fire fighting in respirators would be interested to know to what extent the operator's vision was interfered with by the helmet he wore. He also asked a question with regard to the use of water, which he said was expensive if the town supply was being used. He would like to know whether, if the settling system cleared the sand of silt and sludge satisfactorily, the overflow could be reintroduced into the supply on the suction side of the pump on the city main.

Practical Hints

MR. WEBSTER replied that in any blasting operation vision was always bad. They had designed a special helmet with a particularly wide angle of vision. A jet of water was run over the front of the glass to clear away any splashes or dirt which might interfere with vision. Incoming air kept the inside of the glass free from condensed water and also ventilated the rubber suit worn. The castings were generally illuminated by lamps set in the corners of the room. The operator would not be able to see whether he had removed everything, but if he knew the casting he would remove 95 or 96 per cent. of the sand before he had to examine it. Then the assistant whose job it was to get the castings in and out of the room came along with a torch and pointed out the spots which might have been missed. As to the second question, in America they had not found it practicable, so far, to free the water sufficiently of fine silica abrasive material to dare to put it through a high pressure pump. They used about 25 imperial galls. of water per min., and that water was wasted. They put in as little new water as possible, because the more new water they added and had to dispose of the higher the velocities that had to be contended with, which meant that they had to make a larger capacity sludge removal plant in order to prevent the uprising current in the tank from being too great. Therefore the whole purpose was to keep the amount of new water down to an economical point.

The Economic Minimum

MR. E. R. BRIGGS inquired whether plants had been put in where the firm was dealing with light automobile castings, not only iron but also aluminium and elektron. The speaker also wanted to know approximately what the output of a foundry must be before the plant described could be economically applied to its operations.

MR. WEBSTER replied that the question of cost depended to some extent on the nature of the work. If the work was complex, filled with small internal cores, a capacity of, maybe, 6 tons a day of either steel or grey-iron castings would do. In America, if the output of a foundry was about 8 or 10 tons a day—that was on the small side—they had to be sure that the nature of the work was such as to justify the capital expenditure. The rule has been thus far—and his firm had succeeded in making good on it with one exception—that it has repaid the cost of the equipment within two years. He did not like to undertake a job in the States where he could not show a probable saving within that period of time.

Nature of Reclaimed Sand

Answering the question whether, in the case of steel castings, sand reclaimed after the hydro-blasting process was in all respects equal to new sand, MR. WEBSTER said that grains which had been actually surrounded by hot metal would crack into finer particles. They would be removed in the final classification and wasted. Frequently, steel sands acquired a surface of very hard clay, and sometimes carbonaceous matter, which would lower the sintering point of the sand material. Mr. Webster quoted the experience of an American corporation, where the sand was used for cores and facing, and where, he said, it was claimed that the sand itself was more uniform than new sand. Rather less than one-fifth as many pattern changes were made than previously, because it was possible to control the shrinkage of the cores better with a washed and graded sand than with new sand. New sand varied slightly from load to load.

Jet Regulation

MR. J. W. GARDOM asked whether Mr. Webster recommended the use of the plant for the cleaning of annealed castings; further, was it applicable to castings of 30 or 40 lbs. in weight, steel castings particularly? Could the operator regulate the amount of sand or water coming out of the nozzle? Was the core sand cleaned of any bonding in it?

MR. WEBSTER replied that the practice was to make the core sand out of the moulding sand and lose all the bond. When the casting was pulled out of the box, there was usually sand adhering to it. If, basically, the sand was a silica sand, it would all go through, and the bond would be removed. He added that he had been attempting to establish some measure of cleanliness in sand. As he saw it, there were three ways of measuring the cleanliness of a silica sand. One was to compare a new, washed silica sand and a recovered washed silica sand having identical grain size and substantially the same grain shape, by adding a given quantity of oil or other bond and baking it under identical conditions, so getting a comparison of the tensile strength and permeability. If the silica sand, as recovered and washed, showed lower strength than the new sand, he considered that it was inadequately cleaned. It showed that there was a film on the sand which absorbed oil. There were two other methods. There was the loss on ignition—the actual loss of weight and the actual amount of gas evolved from the sand. On the recovered sand cores showed very little increase in the gas evolved over a new washed sand. They usually exhibited a higher tensile strength under the conditions of the oil bond test than with new sand, which was generally because there was some silt or organic matter remaining in the sand. This cut lower the sintering point. He did not trust the measurements of the sintering point. As to another point raised by Mr. Gardom, the operator could not regulate the amount of water thrown, but he could cut out the sand and throw pure water.

(*Concluded on page* 120.)

West Yorks Specimen Casting

(*Concluded from page* 122.)

cut down the fumes from drying and casting. At present most core binders evolved disagreeable smoke of an assorted taste and smell, and research into this point was very desirable. In spite of fans and exhaust ducts, they still hung about. The question of the chill on the spigot asked by Mr. Blakiston was interesting. It would have to be of a shape to expand freely, and leave easily, and in addition not be used many times if solidity was to be assured. One advantage of cast-in chills was that they were only used once.

There was no soot arising from the use of automatic stokers, as the combustion was so complete. There was not even any smoke, and the moulds and cores were as clean as could be desired. Most foundrymen had seen the heavy white deposit on cores and moulds dried in coke-fired stoves, yet could it be stated that this was a known disadvantage in any way?

A MEMBER said he would not think of putting chills outside, as it would tend to retard the speed and increase the cost of core-making as they have to be rammed up or bedded in.

The BRANCH-PRESIDENT (Mr. Fearnside) said he favoured the use of the chill pin as being the simplest method.

MR. PARKER asked whether a centre chill pin would be permissible, remembering its effect during the drilling operation.

MR. TIMBRELL said he thought no difficulty should be experienced during drilling providing there is no white in the fracture. With chills, the composition would influence it. With very low silicon the white edges would prevent easy machining. Even cast at a lowish temperature with the average high-duty iron there should be no difficulty.

Here an informal discussion took place on core blowing and other methods of bulk production.

Vote of Thanks

The thanks of the meeting to the lecturer were voiced by Mr. Blakiston and Mr. Douglas Jepson, M.Sc., metallurgical lecturer at the Bradford Technical College, who is preparing the final Paper of the series.

Mr. Timbrell, in reply, thanked Mr. Thornton and Mr. Forrest for the help they had accorded him.

The Wet Process of Core Removal, Casting Cleaning and Sand Reclamation

(*Concluded from page* 119.)

MR. J. G. PEARCE: With reference to cleaning sand, are we to take it that the cleaned sand, with the same amount of bonding material, is stronger and more permeable than the original sand?

MR. WEBSTER: Yes.

Reduction of Silicosis

MR. P. PRITCHARD referred to the problem of silicosis, and asked if Mr. Webster could give the meeting any information with respect to improvements effected in the matter.

MR. WEBSTER stated, in reply, that after the system had been in operation for a year, or six months even, the reduction in dust in the foundries was such that an abatement in insurance rates under the occupational disease heading was obtained.

It was announced that another meeting of the Branch was being arranged, and that it was hoped to meet monthly until April or May.

Automatic Malleablising Cycle Control*

The time for annealing malleable iron castings in oil-fired pot-type furnaces at the Eberhard Manufacturing Company, Cleveland division of Eastern Malleable Iron Company, has been reduced 15 to 20 per cent.—saving 18 to 24 hrs. in a six-day heat-treating cycle. Even more important than this substantial increase in output and capacity is the assurance of a uniformly higher quality product. An added value is that fuel is consumed with the utmost efficiency consistent with overall economy due to combustion control incorporated in the Bristol master control system. This improvement is attributed to the entire elimination of manual furnace regulation by the application of positive, yet flexible, automatic heating-cycle control.

There are ten annealing furnaces at the plant, each now equipped with its individual control system. While the heating cycles vary with the character of the furnace, expert standardisation on specific annealing tasks has been affected. Annealing a typical batch of castings may call for a uniform maximum temperature of 937 deg. C. over a period of 24 hrs. This, then, is followed by soaking at this top heat for 30 hrs. Then, to the minute, the temperature of the furnace may be lowered rapidly over an accurately fixed rate of 2.2 deg. C. per hour, until in 40 hrs. every part of the furnace and its charge is cooled down to 650 deg. C., at which instant the furnace doors are opened to permit accelerated cooling prior to the removal of the softened castings.

Each adjustment of fuel control valves and of draft dampers entailed in following with precision such a set thermal cycle is performed automatically and at just the critical instant for each temperature change by a cam-driven time-temperature controller. Coincidently, a continuous graph record of furnace heats is posted on a Bristol wide-strip potentiometer. The contour of the control cam, or disc, of the governing control instrument is in effect the actuating guide for each predetermined best heating cycle. As the cam rotates at a constant speed, it accurately modifies the adjustments of burner fuel supply and furnace draft in accordance with the known heating requirements.

All the skill acquired in expert malleable iron casting annealing is incorporated in the physical form of the control cam, the contour of which exactly follows the set time-temperature sequence known to be productive of the best results. As more or less furnace heat is required to maintain temperature demands of the annealing cycle, a proportional pressure disturbance is created in a sensitively balanced actuating air line by means of magnetic air pilots electrically connected to the controller, thus setting up balancing loading pressures on the diaphragms of pneumatic control valves in the fuel-air lines to the furnace burners. This furnace regulation, conducted entirely automatically and with extreme accuracy, takes place, whether the required modifications in furnace temperature are dictated by the set heating cycle for which the control, or programme, cam is proportioned or by other considerations.

Sensitive thermocouples are located at three locations in each furnace in protecting wells that each house two independent couples, one of which is connected directly to the wide-strip potentiometer and the other to a three-point switch on the instrument board serving the furnace. Each furnace also is equipped with safety devices for protection against possible power failure, loss of adequate actuating head in the air line to the various pneumatically operated diaphragm control valves, and the development of dangerous furnace temperatures by any cause whatever.

UNITED STATES production of malleable-iron castings in the first ten months of 1941 amounted to 704,989 tons, as compared with 448,051 in the like period of 1940. Production of commercial steel castings in the ten months aggregated 1,079,904 tons and compares with a total of 1,353,118 tons for the peak year of 1929.

* From a short paper in "Steel" by R. Trautschold.

Publications Received

Index to A.S.T.M. Standards. Issued by the American Society for Testing Materials, 260, South Broad Street, Philadelphia, U.S.A.

Readers familiar with the B.S.I. publications readily will grant the real utility of the annual index of specifications. This sister publication from the U.S.A. serves the same purpose and is not dissimilar in either size or make up. The total number of standards listed is 383, plus 151 still in the tentative stage. Additionally there are 475 methods and 34 definitions covered within its 196 pages. The number of specifications which have been discontinued is eloquent tesimony that even when a specification has been removed from the "tentative" class, finality for ever has not been attained—and this is as it should be if specifications are to serve their true purpose in promoting progress.

The Metallurgist's Note Book. Compiled by A. G. Larkin and H. R. Nuttall, 24, Ordish Avenue, Chaddesden, Derby.

The compilers, believing there is a demand for a notebook containing information directly applicable to one's work and free from extraneous matter, have devised a system of providing loose backs to contain a selection of printed leaflets, each of which is sold separately at the cost of a few coppers. The matter so far available covers sampling and the estimation of sixteen elements in iron and steel; four on various phases of coal and coke analysis: and seven on foundry sand.

Restoration of Trade Practices

At the second reading of the Restoration of Pre-War Practices Bill recently, MR. ERNEST BEVIN (Minister of Labour) said the purpose of the Bill was to restore after the war, in accordance with the Government's pledge, the trade practices departed from during the war. Having regard to the size of our labour force, the change in its distribution and composition, the necessity for rapid adjustment in character and methods of production and in many cases the complete change in piecework rates due to those changes, it was remarkable that the amount of time lost through disputes represented only one-fifteenth of a day per year for each worker employed since war broke out. All these changes of a voluntary character that were arrived at were on the basis that they were for war purposes and would be restored after the war. The Bill was not concerned with wages, but with rules and practices of custom with respect to the class of persons who would or would not be employed, the conditions of employment, hours of work and working conditions. The Bill's intention was to re-establish temporarily the practices existing immediately before the war. It was intended to operate in the eighteen months after the war and applied equally to employers whose undertakings were begun during the war.

Colombia Steel Plant

According to Press reports, Colombia will be producing steel at Medellin within a few months. The machinery, costing about 400,000 pesos, has been ordered from the United States. It is understood that the enterprise is capitalised at 2,000,000 pesos. The project has stimulated much interest in Antioquia, and while deposits of iron ore (containing as much as 38 per cent. iron), coal and limestone are available nearby, the demand for steel scrap in Medellin has increased considerably. It is reported that the mill has contracted for large quantities of scrap, consisting of rails, wheels, axles, old automobiles, and all types of iron and steel in any form. The price for scrap is 9 to 11 pesos per metric ton, which is considered very low. The plant is expected to use available scrap before exploiting the ore deposits. Manganese is also reported to be plentiful in this area.

West Yorks Specimen Casting

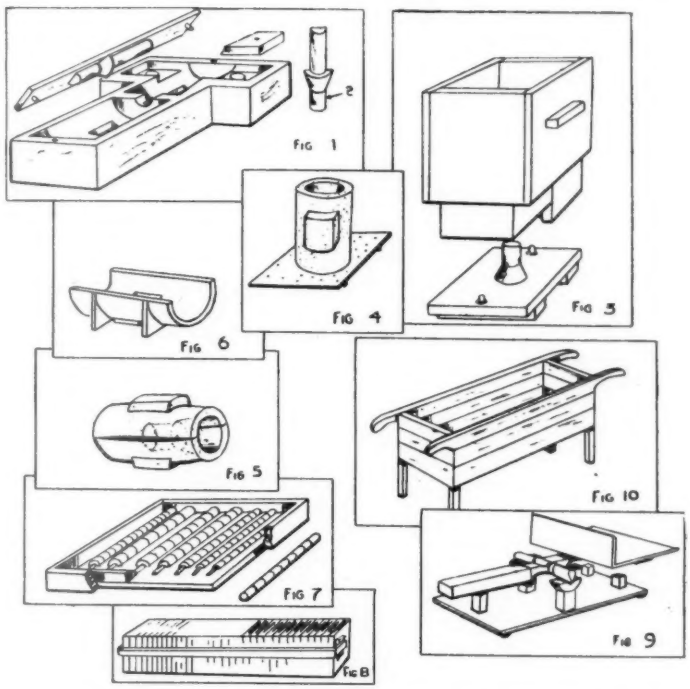
II—CORE-MAKING AND CORE-DRYING

At the December meeting of the West Riding of Yorkshire Branch of the Institute of British Foundrymen, discussion was resumed on various stages in the production of the specimen casting described in THE FOUNDRY TRADE JOURNAL of November 20 last, the stage under consideration at this meeting being the core-making side. At the November meeting, moulding problems and practice were discussed (see THE FOUNDRY TRADE JOURNAL for January 22).

MR. J. TIMBRELL opened the session with the following contribution.

Core-Making Problems

A short introductory Paper of this kind, addressed as it is mainly to foundrymen of wide experience, is in contrast to lectures sometimes given that are highly scientific, and to practical moulding-shop leaders the findings are occasionally hard to follow and often hard to apply, so, if much of this Paper on the methods and descriptions appears somewhat elementary, it is hoped that they may form the basis for some discussion later.



At the outset, it may be useful to refer to the sand models (exhibited), which will help to cover many of the points mentioned and are common to this style of core-making. There are two cores, and in each case the spigot boss has to be formed on the inside of the cores, either by bedding in split half-boxes or ramming up from the open end of a full box, with the whole spigot in place on the bottom, as in shown in Fig. 3.

Bedding-in has disadvantages; usually the half-spigot is fastened to a cross-member with dowels, but this has to be rapped down into place, and unless large dowels are used or substantial side pieces. After repeated use the tendency is to get the spigot out of line, when the two halves of the core are put together the spigot is cross jointed. Moreover, with bedding-in, unless the core sand has a good green bond and air-drying qualities, packing sand has to be rammed in to maintain a true shape after turning the core out on to a coreplate (Fig. 4).

For quantity production cast-iron packers, put in and left in during the drying, will preserve a true shape, as is indicated in Fig. 6. Another way is to dry one half-core and turn the other half on to it, a method which saves jointing.

The other method for making a full core is to form a full spigot on the bottom "lid" and ram up in one piece from the open end. No spigot packer or packing sand is necessary with this way, but a well-bonded sand, capable of maintaining its shape in the green condition, is required. One or two points in favour of this method are:—(1) It eliminates jointing, and (2) generally gives a better-shaped core.

Level core plates are indispensable for true half-cores, for any cores not dead flat when assembled will cause flash at places where it is not easy to clean out. Rubbing two uneven cores together to make a joint will aggravate the error by reducing the diameter of the spigot and the core body itself will be out of round, and thereby causing flash in the bottom opening when the core floats under pressure during the pouring of the mould. This is shown in Fig. 5.

For intensive production of large orders, dummy half C.I. boxes are the best; these are easily formed from a sand block made from a half core and filed away to even section all over.

Chilled Pins

Digressing for a moment, chill pins were mentioned in the last lecture. Prints for these should, of course, be added on to the spigot pattern, and where the cores are assembled in the mould in halves, a check for alignment ensures accuracy. If the cores are in one piece, the chill pin can be pushed back into one core and brought forward into the other, when the two cores are in place in the mould.

It may be of interest to describe a method of making these C.I. chill pins in quantity from a reversible half corebox. Several different sizes of half patterns are set out equidistantly on the bottom of the corebox. The two halves are put together and several of these moulds are assembled in a row, a long clamp being used to hold them. If the pins are V-notched every half inch, they can be broken off flush with the face or broken to length as required. Short lengths of pin can be put into the centre of bosses, and will ensure a sound hold for screwing, etc.

As regards the question of core sands and their uses with different types of core-making and machines, conditions are largely governed by circumstances prevailing in routine practice, for any set of conditions which are good for one shop, may be unacceptable for another.

The Ideal Core Sand

Ideal characteristics for core sand are high green bond strength; easy ramming; freedom from "clogging" without the use of parting powder; quick hardening out or air evaporating; high dried strength to last just long enough for the metal to set around it and then collapse or revert back to its original state, so as to ensure easy fettling; free venting and completely waterproof in a green mould.

Can all these qualities in a core sand be had at one and the same time? Taking them in their order. First, the more putty-like the sand the better it will keep its shape prior to stoving, but it is harder to ram and is unsuitable for jar ramming and impossible to use in a core blower. This type of high green bonded sand usually has good air-drying properties, but for thin-section castings would not burn away enough to allow cooling without the risk of cracking, and these are also hard to clean out from awkward places.

For jar-ramming, a powdery sand is the best, one that will pack evenly with the jolts. This style of sand is usually friable till it is dried and requires packers or packing sand for support on bigger sizes. Porosity or permeability is important too, the harder the core with certain binders the more liable to blow and the greater the need for more artificial venting.

Resistance to mould moisture is also expected where cores are used in green moulds. Oil content is one of the agents in core binders to bring this about.

Sand Binders

There are many binders available—some are recommended for use with dried sea sand, another may be mixed with sea sand as received with a certain amount of oil and the addition of a starch powder. In a foundry without any drying facilities for sea sand, this is a useful and satisfactory type.

In any case, weights and measures are indispensable if uniform results are to be obtained. If 400 lbs. constitutes a batch, then the correct amount of binder should be added each and every time. If a hopper loader is not available, a handy skep such as is shown in Fig. 10, filled twice perhaps, would ensure the correct amount each time.

Core Sand Mixers

Sand mills are not always suitable, and machines with a rubbing or churning action and close mixing are preferable. Most of these machines will mix certain classes of binder into sand so well that the longer it is kept mixing, the more putty-like will the sand become.

Drying temperatures are usually of the order of 300 deg. C., more or less. Recording or indicating clocks are very useful and help toward more consistent results.

Core Stoves

There may still be some of the old-fashioned directly heated fireboxes about, but the efficiency to be had from the hot air circulating type make the others almost obsolete. The hot air type of firebox is a simple concept. Air is forced under and over the fire proper, and temperature is controlled by setting the

West Yorks Specimen Casting

appropriate dampers. The only criticism, if any, is that the stoking is done by hand and it is recommended to be little and often. The air circulation inside the stove carries away the moisture and gas from the cores. They are very simple to add to many existing types of drying stoves without flue alterations.

It may be of interest to describe a later development which can be added to almost any stove, the automatic stoker; these are a great asset and really do almost run themselves. There is only the hopper to fill and very little to take away in the form of ashes, combustion being so near complete. There is also a useful electric mechanism which can be built into this system. It consists of a thermostat to cut in and out at, say, 300 deg. C., as often as required. This feature prevents burnt cores. A time switch is also a useful asset; it can be set to start up and stop at any predetermined time for whatever drying time is allowed. A shear pin is fitted into the drive and any stoppage is indicated by this making contact to ring a bell or put on a light in the watchman's office.

DISCUSSION

A Question of Design

Before proceeding to the discussion on Mr. Timbrell's Paper, the secretary of the Branch (Mr. S. W. Wise) reported receiving a letter from Mr. A. A. Liardet, first President of the Branch, 1922-3-4, now general manager of the Leyland Motor Company, who wrote that he was greatly pleased and interested to note the manner in which his old Branch was maintaining its programme in spite of wartime difficulties. Mr. Liardet offered a little friendly criticism on the specimen casting under consideration in the present series of Papers and discussion.

"I am sure you will not mind an ex-President's criticism of the design," he wrote. "I am sorry I cannot join you at the meeting. Is there not a too abrupt change of section? Cannot the boss be tapered at the base as on the lower side, otherwise porosity is almost sure to occur in the spindle hole?"

MR. W. G. THORNTON, referring to Mr. Liardet's comments, said he and the members were delighted to know he was watching the activities of his old Branch with evident interest. In defence of the design of the specimen casting and speaking as one of those who had collaborated in the preparation, he said, that if he and the others concerned had been designing it to make in their own foundry, they would not have designed it quite in the way they did. The sole purpose was to create probable snags and some difficulties which would provide some ground for thought and ingenuity and to find ways and means of overcoming them. Mr. Liardet suggested that there be a more uniform section, and he (Mr. Thornton) did not disagree with him. The reason that the spigot on one side of the casting was made parallel was that it took the valve spring; this was necessary. The taper on the other side behind the valve was to create easy flow for gases.

The meeting agreed with Mr. Thornton, and Mr. H. Forrest suggested that they should write to Mr. Liardet giving him more details in reply and an explanation of the intended design and purposes.

MR. TIMBRELL commented that this point of view had been discussed many times. The design was not easy to alter in important details, and the idea was that such a casting was essential to performance. If foundrymen had more control in the shaping of a difficult casting, the latter would probably be a sound job, but whether their design would be the best, or equal to the requirements, would be another matter. There were so many points of view from the designer's angle, such as easy machining and assembly, reliability in service, resistance to heat, etc., that it must be assumed that they have been considered by draughtsmen when dealing with these awkward castings.

Stove Design

MR. WISE, speaking in reference to the stove fireboxes described, asked Mr. Timbrell if he thought fan and motor fixed as it was shown was satisfactory, and, had he experienced any trouble with the hot gases coming back up when the motor was stopped and damaging the windings and insulation.

MR. TIMBRELL said the motors were usually fixed directly over the air box as a complete unit. It was perhaps advantageous and was done in many cases to instal the fan and motor at a convenient place, bearing in mind the extra piping, bends, etc. If the damper to the fan outlet was not closed and the flue dampers were open, hot gases would blow back, with possible damage to the motor. The type of flap indicator shown in the automatic firer prevented this, and it was surprising this was not more widely used, as it also acted as an indicator. The question of the fan being above or below was a point he had not considered, and he doubted if that point much influenced the drying capacity.

MR. WISE said he still thought that, if the motor was above the level of the firebox, there was a tendency to get the hot gases back.

MR. W. PARKER said he had had this system described by Mr. Timbrell running for five years, and had never had trouble with gases damaging the motor. There was a gap between the motor and fan, and also a greaser, which perhaps avoided the possibility of the trouble mentioned.

MR. TIMBRELL said he believed the fan and spindle were in one piece, and the fan casing either attached to the motor housing or at least very close. The intake was usually open at the front and protected by a grill, and, incidentally, in two cases recently this was operated by a louvre to control the intake pull.

MR. PARKER said he failed to see any advantage in putting the fan at any particular place or level, because if there was a back draft, argument ceased.

MR. TIMBRELL pointed out that provision was made to take care of this point and, if attention was taken to close the damper when the fan was stopped, there was no possibility of damage. In the case of the flap, this point did not arise.

MR. H. FORREST said the Paper might have enlarged on the hot air circulating inside the core stove; this was a point not given adequate attention. With regard to the fan and the risk which Mr. Wise had mentioned, he had had a fan motor damaged through placing it on top. It was shifted about 30 ft. away to the most convenient spot for piping, etc., and it had run ever since without further mishap. The trouble in his case was due to the stove bricks communicating the heat to the bearings. He agreed with Mr. Timbrell that the top of the stove was suitable if there was air circulation round it.

Chill-Stick Practice

MR. TIMBRELL mentioned the chill stick through the centre of the casting as a means of producing solidity. He was not convinced that this was necessary. An improperly baked core will often give a defective casting.

MR. TIMBRELL said his personal belief was that the flues on a stove largely promoted efficiency. It was possible to have a section of a stove almost without heat and excessive heat in another part with improperly laid-out flues. Damper adjustment, when once found, was a factor, and obviously the more rapid the circulation of hot air, the better. If a small pressure can be developed inside the stove, cold pockets have a chance of being dispersed, providing the stove doors did not leak too badly, this could be done by damper adjustment.

As to the use of the chill pin, it was surprising the solidity that could be obtained without them when the mixture was of suitable analysis, but the choice of low phosphorus and carbon irons was somewhat limited, and one had to ensure as far as possible soundness in all machined holes. Chill pins allowed a wider tolerance in mixture composition, and, personally, he was an advocate of chills and felt safer with them than without, providing they were used with accuracy in location.

MR. FORREST asked whether chills did not tend to transfer porosity to another position.

MR. TIMBRELL recalled the saying that there was no such thing as an entirely sound casting, and the idea was to move porosity to where it could not be detrimental, or be seen.

MR. FORREST said that, whilst agreeing that much depended on the way the matter was tackled, he still insisted that a chill pin was unnecessary.

Remote Fan and Motor

MR. THORNTON, reverting to the fan and air pressure, said it was policy to put it as near the job as possible, as it saved piping and was generally a neater job. By taking the fan 30 ft. away, would it not mean a bigger fan to avoid loss of pressure? If there was an air gap between the motor bedplate and the stove top, where the heat was, heating up was avoided. For full efficiency the fan should be on top of the job, not away from it.

MR. FORREST said the object of taking the fan 30 ft. away, as was done in his case, was that it was more or less out of the way, and he had not found any less efficiency, and he was happier about it now. Mr. Forrest, referring to the sand question for cores, said he agreed with the author that it was sometimes desirable to have a sand which would air dry, but there were times when it was inconvenient for this to occur, and it can be brought about by adding a small amount of bentonite; this removed stickiness and would still keep the sand putty-like. It increased the dried strength. This tip was useful in summer, when the air drying was quicker.

Foundry Trends

MR. J. BLAKISTON said the Paper was interesting and an important one, because, for one reason, the present trend of foundry industry was to increase core-making, and that trend, through design, was going to persist. In many foundries at present the ratio was a ton of cores to a ton of castings or less, and that meant core-making must be gone into as fully as moulding production had been in the past two decades. Oil sand had had its hey-day. The industry had been through the cereals and bitumastic binders to produce green bond. Fumes would be eliminated by new methods and materials. After the war many munition works would be going on to synthetic resins, which would find their way into the foundries in various forms. Next there would be much less new sea sand used, and a showing of 50 per cent. economy on sand used by employing bentonite or something similar.

Referring to the fireboxes illustrated, Mr. Blakiston said that many existing types of these would become obsolete. Some of the coal-fired ones were liable to give a sooty coating to the moulds and cores. If the specimen casting had to be chilled, he would suggest chilling the part where the spring seats on the spigot.

No Soot Problem

MR. TIMBRELL commented that Mr. Blakiston's remarks about sand sounded revolutionary, and he welcomed any development which would

(*Concluded on page* 120.)

Plastics and Their Use in Engineering

GENERAL PROPERTIES AND POTENTIALITIES

The steady growth of plastics as competitors of metals demands the attention of metallurgists generally, for as extraordinary physical properties are possessed by certain plastics, they are already offering a serious challenge to metals in certain directions. The future of plastics in engineering generally, discussed in a Paper read by DR. A. CARESS at a recent meeting of the North-East Coast Institution of Engineers and Shipbuilders, is therefore of unusual interest, especially those sections devoted to the properties, current engineering applications, and potentialities of plastics.

Range of Properties

The following general summary of the range covered by typical properties of the more familiar plastics indicates the stage reached at the present time.

Density.—Densities range from about 0.95 (polythene) to 1.7 (polyvinylidene chloride). Much lower densities are obtained, of course, by foaming the resins and higher densities by the use of heavy mineral fillers. Cf. glass about 2.5, aluminium 2.7, steel 7.8.

Tensile Strength.—The range of tensile strength varies from 2,000 lb./sq. in. for polythene, 4,000 upwards for cellulose derivatives, 6,000 for polystyrene, 9,000 for polymethylmethacrylate, to 20,000 for rolled nylon sheet. The tensile strength of the three-dimensional plastics depends on the filler, *e.g.*, unfilled p.f. 6,000 to 9,000, cellulose filled phenol-formaldehyde and urea-formaldehyde mouldings 8,000 to 9,000, p.f. laminated up to 30,000 and special fibre reinforced p.f. up to 60,000. Cf. duralumin 60,000 and steel about 200,000 lbs./sq. in.

The effect of cold-drawing is most marked. Polythene increases to 5,000 to 14,000, "Saran" (an interpolymer with vinylidene chloride preponderating) is claimed to have a tensile strength up to 60,000 lbs. per sq. in.; nylon increases to between 50,000 and 120,000, depending on the method and extent of drawing.

Ultimate Fibre Strength in Bend.—The trend of tensile strength is naturally followed by the bend strength, which, however, is higher in plastics, *e.g.*, 5,000 lbs./sq. in. upwards for cellulose derivatives, 7,000 for polystyrene, 14,000 for polymethylmethacrylate, 16,000 for "Saran," 10,000 to 12,000 for cellulose filled p.f. and u.f. mouldings, with laminated correspondingly higher.

Compressive Strength.—The range for linear polymers is 10,000 to 15,000 lbs./sq. in. P.f. and u.f. are higher, *e.g.*, mouldings and fibre-reinforced products have compressive strengths up to 35,000 lbs./sq. in., approaching that of duralumin.

Young's Modulus.—Unfilled plastics do not approach metals in elastic modulus. The normal range for the thermoplastics is $2 \times 10^5 - 5 \times 10^5$ lbs./sq. in., with some cellulose derivatives down to 1×10^5. The thermosetting plastics, as would be expected from their cross-linked structure, have higher moduli, $7 \times 10^5 - 10^6$ for unfilled p.f., going up to 7×10^6 for fibre-reinforced p.f. Cf. duralumin 10^7 and steel 3×10^7 lbs./sq. in.

Impact Strength.—Plastics are generally brittle compared with metals and again the thermosetting plastics do not compare too favourably with the thermoplastics, unless they are fibre-reinforced. Published figures are not always reliable because the exact method of test is not always stated. The probable order, in increasing impact strength, is:—Unfilled p.f. and cellulose filled p.f. and u.f. mouldings, polystyrene, polymethylmethacrylate, cellulose derivatives (which, however, become brittle below 0 deg. C.), polythene, fibre-reinforced, p.f., cold-drawn nylon.

Hardness.—With a 2½ mm. dia. ball and a 25-kg. load, Brinell hardness figures range from 20 to 50 (p.f.), with nylon considerably harder. Cellulose derivatives and polythene are below 20. The abrasion resistance of typical transparent plastics is indicated by the following relative figures:—Polystyrene 12, "Perspex" (plasticised polymethylmethacrylate) 18, cellulose nitrate and acetate 22, polymethylmethacrylate 30, glass 130.

Thermal Properties.—Conductivities range from 10^{-4} to 10^{-3} c.g.s. units. Specific heats are between 0.25 and 0.5 per deg. C. Linear expansion coefficients per deg. C. are between 1.6×10^{-5} and 1.6×10^{-4}, generally higher than metals, cellulose derivatives being highest.

Useful Temperature Range.—Most plastics can be used at temperatures down to at least −40 deg. C. The linear thermoplastics weaken with rising temperature and the upper limit for continuous service is around 60 deg. C. for some plasticised compositions even lower. Nylon with a sharp melting point of 264 deg. C. can be used up to temperatures approaching 200 deg. C., but attack by oxygen becomes a limitation at high temperatures. The thermosetting plastics are naturally less affected by temperature, but cellulose-filled p.f. mouldings are serviceable at 140 deg. C., with heat resisting fillers up to 180 deg. C. or higher. The word "softening point" is used unfortunately with a number of different meanings and, unless defined more exactly, it cannot be taken as any indication of the upper limit of temperature at which a plastic can be used.

Current Engineering Applications

Figures show that the strength of metals is most nearly approached by the special fibre-reinforced phenol-formaldehyde, the next best being paper or fabric laminated p.f. It is, therefore, not surprising that these materials have made the greatest progress in engineering applications. The electrical engineering uses of phenol, cresol and aniline-formaldehyde laminated rod, tube and board are well known.

At first plastics came to be used as substitute materials, replacing wood, ceramics and metals. This was due to the combination of a large number of desirable properties in plastics—ease of colouring, resistance to chemical attack, low electrical and thermal conductivity, and ease of moulding, drilling and machining. Latterly, plastics have been used to supplement supplies of metals and light alloys; but there is a growing use of plastics, not as substitutes, but because they are specially adapted to the application, sometimes even because they are the only possible materials for a novel use. Water-lubricated bearings and silent gears are familiar examples. Modern bomber and fighter aircraft depend for their streamlined cockpits and turrets on transparent methacrylate or acetate sheeting. When the war is over, it will be possible to mention numerous new applications where lightweight, electrical and chemical properties and ease of manufacture have pointed to one plastic or another as the only possible solution.

The use of plastics as constructional materials has received an impetus from the demand for saving in weight. That is one of the reasons why the aircraft industry is making greater use of plastics. Phenolic and urea resins are used, sometimes in combination with plywood, for the stressed skin structure of wings and fuselages. The transparent parts of the aircraft shell are also subject to stress in service, and their low weight, as well as their ease of shaping, is an important factor in their use. Other industries will utilise these advantages, especially where weight-saving is important, *e.g.*, in cars, trains, ships and boats. A specialised application of plastics, in which the density is further reduced artificially, is that of foamed resins in the thermal insulation of refrigerated ships' holds. Small craft have been made in synthetic resin bonded plywood, and canoes have been made by stretching plastic sheet (based on polyvinyl chloride) over wooden frameworks.

Amongst the mechanical uses of plastics, bearings and bushes made from phenolic laminated have been mentioned. Roll-neck bearings up to 30 in. dia. have been made for steel mills; the power consumption is reduced and water-lubrication is possible. Nylon bearings are used in smaller sizes. Silent gears, clutches, pinions, etc., are further applications of laminated plastics. Moulded impellers, pump casings and fans are also used where chemical resistance is required.

A considerable development of the use of plastics in chemical plant, tank wagons, etc., is to be expected. Corrosion-resistant tanks, vessels, valves, ducts, and pipes are made from asbestos-filled phenolic plastics. Progress in Germany in the use of semi-rigid piping extruded from compositions based on polyvinyl chloride, is likely to be followed here, when the advantages of ease of jointing, resistance to attack by a variety of corrosive chemicals and light weight are fully realised.

Potentialities of Plastics

It is safe to predict that, in the normal course of development of existing plastics, uses in all branches of engineering will increase. Another safe prediction is that the strongest and most stable of the transparent sheet plastics will find wider use as light structural materials. The chemical engineer will also use extruded plastics, such as the more rigid compositions based on polyvinyl chloride, to solve corrosion problems which previously demanded special alloys. Simple welding and jointing methods will be employed in manipulating extruded tubes and sheets, and there will be a general trend towards fabricating large articles by adaptations of metal working techniques.

In comparing plastics with metals, two fundamental differences arise from their different structures. The close packing of metal atoms in a crystal, in which identical atoms are held together by *undirected* "metallic" bonds, can be maintained when atoms glide past one another; this explains the ductility of metals. The three-dimensional plastics are non-ductile; when they yield, they break. This is because the primary bonds are *directed;* when such a bond is broken, the chance of its being re-formed is very slight. On the other hand, the Van der Waals forces are undirected, so there is a better chance of their being restored, particularly if the long molecules are straight and parallel. Hence, the oriented thermoplastics show some ductility—not approaching that of metals—and the isotropic thermoplastics are very slightly ductile.

The other property of metals which cannot be approached by pure organic materials arises from the loosely bound outer electrons in the metal atoms, that is, electrical and thermal conductivity. For some applications the low electrical and thermal conductivity of plastics is an advantage. In others, it has to be allowed for, and with it the high thermal expansion of plastics.

There is much to learn about the properties of plastics as engineering materials, and about the best way to design in order to make use of those properties. Far-sighted engineers will start building up that knowledge in order to extend the uses of the oldest and the newest plastics and in anticipation of the improved plastics to come.

Copper Used in Castings Industry

J. E. JACKSON, of the U.S. Copper, Iron and Steel Development Association, estimates that on a conservative basis between 10,000 and 12,000 tons of copper were used in 1940 by the U.S. steel industry as an alloying element. Use of copper as an alloying element by the ferrous casting industry in alloyed cast iron, malleable iron, and cast steel, has expanded considerably within the past five years. In the alloyed cast iron industry, copper in the form of scrap or copper shot is used extensively, and is generally added to the spout or ladle during tapping from the melting furnace. Approximately 6,000 tons of copper was used for this purpose during 1940. During the same year, the malleable iron industry used approximately 600 tons of copper, and the cast steel industry used approximately 1,500 tons of copper. As a conservative overall total estimate, approximately 18,000 tons of copper was consumed by the U.S. iron and steel industry during 1940.

Bureau of Standards Metallurgical Laboratory

A $600,000 laboratory is to be built for the Bureau of Standards for metallurgical investigations required under the defence programme. Since the Bureau's present tunnel for testing steel geodetic tapes is not long enough, a feature of the new building will be a new 200-ft. tape tunnel.

Hours of Work and Lost Time in Factories

MEDICAL RESEARCH COUNCIL REPORT

In 1940, the Industrial Health Research Board of the Medical Research Council issued its first Emergency Report, outlining the general conclusions of the Health of Munition Workers' Committee of the last war and the research work of the years between the two wars, in so far as these related to industrial work and fatigue, to the environmental conditions—lighting and vision, heating and ventilation—and to the problems of accident proneness and sickness absence. Although the primary need during the present war so far has been for the practical application of knowledge of industrial physiology and psychology already gained, further research under the prevailing conditions of industrial work was clearly desirable. To make this extension the Board has now issued Emergency Report No. 2,* entitled "Hours of Work, Lost Time and Labour Wastage."

This second Report accordingly gives the results of an investigation made in a number of munition factories during the period from the outbreak of war until the end of June, 1941. It also deals with the question of hours of work, and with some of the hindrances to maximum output, including lost time, labour wastage and, for a few factories, the differential diagnoses of sickness absence. Much of the substance of the present Report was recently given in evidence, on behalf of the Board, before a sub-committee of the Select Committee on National Expenditure. The Report is in three parts: (1) Lost time; (2) hours and output; and (3) labour wastage.

Lost Time

Factory records of lost time usually refer to absenteeism during the normal week of 47 hrs. and take no account of lost overtime. As a rule, the latter is relatively much higher than the former, hence the figures obtained under-estimate the total loss. Subject to this limitation, the results collected in this inquiry show that the time lost due to sickness, injury and absence without permission, when undisturbed by other extraneous factors, varied with the weekly hours of work. It was usually reasonably low when the hours of work were less than 60 per week, but was higher, and in some cases excessive, when the hours were from 65 to 75 per week. The increase during the height of the 1940 emergency period (June and July) was due mainly to the fatigue, strain and ill-health caused by the longer hours of work, and there is little doubt that a continuation of these hours would have had serious and far-reaching effects. The introduction of week-end breaks, which became fairly general in August, together with holiday rota schemes, was followed by an improvement; and from then onwards there was little evidence that the hours of work were responsible for more than the normal amount of fatigue. The increasing percentage of time lost after September was due partly to seasonal causes and partly to the effects of air-raids on home life and to difficulties of transport.

Women lost more time than men, even when the type and conditions of work were fairly similar for both sexes, and for this home duties and family responsibilities were largely responsible. A substantial part of the total time lost by both men and women was due to sickness. Unexplained absenteeism of comparatively short duration rose fairly sharply after the hours of work were increased. As might be expected, voluntary absenteeism increased at week-ends, especially during the seven-day week.

Hours and Output

The data obtained in this investigation, though limited in number and scope, have been carefully compiled and may be regarded as small samples drawn from widely different types and conditions of work. Further, the validity of the results is increased by the records having been restricted to the same individuals throughout the period covered by the inquiry. Though not conclusive, the results give some indication of the nature and effects of factors which increase or retard productive effort.

(*a*) In all the groups, the rate of working was undoubtedly stimulated by the state of emergency, and the appeal for more production, in the latter part of May, 1940. Workers throughout the country were inspired to make good the material losses incurred as a result of the collapse of France; and the effect of this effort was reflected in the increased production obtained. As might be expected, the strength of this incentive gradually waned, but there is reason to believe that it always remained above the pre-emergency level and from time to time was stimulated by successes and depressed by defeats.

(*b*) The appeal for more production was accompanied in most factories by an increase in the weekly hours of work, and the longer hours, together with the extra effort made by the workers, resulted in an immediate and substantial rise in weekly output. This initial spurt, however, was usually followed by a fall in both the hourly and the weekly outputs, which continued at a varying rate until the hours of work were reduced. The chief cause of this decrease was the additional fatigue and strain induced by the long hours of work. During this period the amount of time lost through sickness, injury and absence without permission rapidly increased, and the workers tended to become listless and stale. The reduction in hours which came into operation at varying times in June and July caused improvement in the mental and physical health of the workers; it also stimulated the incentive to work.

It was also generally agreed that the long hours of work impaired the efficiency of the machines, because of the greater wear and the lack of time for adequate overhaul and repairs. Both minor and major stoppages became increasingly frequent, and the drop in weekly output observed in some groups in June, July and August, 1940, was due partly to this cause. The situation was sometimes aggravated by shortage of skilled maintenance men.

The results obtained were influenced by many factors, and it would be useless to attempt to draw hard-and-fast conclusions regarding the relation between hours of work and output. All that can be said is that the long hours in June and July, 1940, plus the extra effort made by the workers, were usually detrimental to sustained productive effort, while the later results suggest that there is little to gain, and probably more to lose, when the weekly hours of work exceed 60 to 65 for men and 55 to 60 for women. Finally, the higher hourly output observed in most groups from June, 1940, to March, 1941, despite the longer hours of work, is evidence of the increased effort made by the workers in response to the national appeal for more production.

Labour Wastage

During the year ending June, 1941, labour wastage was high in some factories, but low in others. It was higher for women than for men. Factors contributing to a high rate of wastage were:—(*a*) The rapid expansion of industry and the employment of many workers, especially women, who were unused to factory life; (*b*) the employment of an increasing number of married women who found it difficult to combine factory work with home duties and family responsibilities; (*c*) the additional strain imposed by travelling long distances to and from work; (*d*) the effect of air raids on home life and transport, especially during the latter half of 1940; (*e*) the lack of suitable facilities for meals in some factories; (*f*) the inadequate supervision of new workers.

(*Continued from next column.*)

General introduction, by Dr. S. L. Smith; (*b*) "Lattice Distortion and Strain," introduced by Dr. W. A. Wood; and (*c*) "Crystal Texture," introduced by Dr. L. Frommer.

Further details may be obtained from the Secretary, the Institute of Physics, the University, Reading, Berks.

* H.M. Stationery Office, York House, Kingsway, London W.C.2. Price 6d. net.)

MODIFIED SINTERING MACHINE

An improved sintering machine designed to reduce installation, operating and maintenance costs below those of any previously designed machine was recently exhibited by C. E. Agnew. The overall design of the Agnew machine is similar to the well-known Dwight-Lloyd type in that it consists of an endless train of movable grate bar pallets. The Agnew pallet, however, is wheelless and the pallet train is propelled by a rack cast in the pallet. The complement of the wheelless pallet is the stationary roller trackway with curved sections of roller trackway at the ends of the machine as well as rollers on the horizontal planes. The simple feature of this combination of ideas is the accurate bearing surface on the side walls of the pallet in contact with the curved section of the roller trackway at the ends of the machines which guides the pallet around the ends and delivers it to the opposite horizontal section of trackway.

The Agnew pallet is a simple casting which does not require any shop work; a minimum of surface grinding which can be done with a portable grinder prepares the casting for the machine. Considering the fact that the largest part of the cost of the conventional pallet is shop work the savings here are of major importance in both original installation cost and in later replacement or maintenance cost.

The roller trackway consists of channels, both straight and curved sections, in which are mounted roller bearing wheels. Wheels of adequate carrying capacity can be purchased ready for mounting at a much lower cost than it is possible to get a good wheel for the conventional pallet. The stationary roller trackway has several advantages over the wheels mounted on the pallet. Because of the constant radiation of heat from the pallet train and particularly because of the constant transmission of heat from the body of the pallet through the wheel shaft directly into the bearing, adequate lubrication of pallet wheels has always been a difficult problem, but with the stationary wheel lubrication is a simple mattter.—"Blast Furnace and Steel Plant."

X-RAY ANALYSIS IN INDUSTRY

CAMBRIDGE CONFERENCE IN APRIL

A conference organised by the Institute of Physics on X-Ray Analysis in Industry, is to be held on April 10 and 11 at Cambridge, to promote the interchange of knowledge and experience between those employing X-ray analysis (diffraction methods) in their work in different fields and to arrange for further collaboration between physicists, engineers, chemists and others towards the solution of problems by its methods. The conference will be open to all interested without charge. It is intended that the discussions shall be informal, and they will be based on Papers included in a symposium recently published by the Institute of Physics. The conference will be opened at 2.15 p.m. on Friday by Prof. Sir Lawrence Bragg (President). At 2.30 p.m. there will be a discussion on "X-Ray Analysis Cameras": (*a*) "The Circular Camera," introduced by Dr. A. J. Bradley; (*b*) "High-Temperature Cameras," Dr. W. Hume-Rothery; (*c*) "Low-Temperature Cameras," Dr. K. Lonsdale; (*d*) "Focussing Cameras," Prof. E. A. Owen; and (*e*) "Preparation of Specimens," Dr. C. Sykes.

At 8.30 p.m. Prof. Sir Lawrence Bragg will deliver a lecture on "The History and Development of X-Ray Analysis." On Saturday, at 10 a.m., discussion will take place on "The Applications of X-Ray Crystallography to Industrial Problems":—(*a*) "Chemical Problems," introduced by Mr. C. W. Bunn; and (*b*) "Refractories," introduced by Dr. A. H. Jay.

At 2.30 p.m. there will be a discussion on "X-Ray Structure and Mechanical Properties":—(*a*)

(*Continued in previous column.*)

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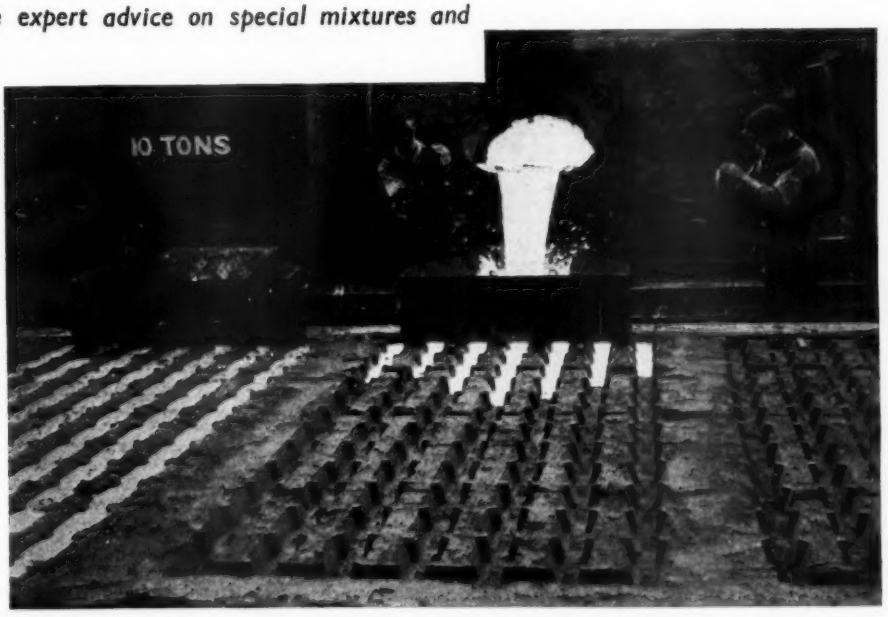

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Fuel Questions

COAL OUTPUT AND CONSUMPTION

Action and comments by Government departments upon recommendations contained in the series of reports made to Parliament last year by the Select Committee on National Expenditure are recorded in the Committee's first report of the new Session, published by the Stationery Office last week. In their 16th report the Committee expressed the opinion that closer consultation was needed between the Mines Department and large industrial users of fuel, so as to provide them with the grades required.

In reply, the Mines Department now states that consultation is normally achieved through the Department's regional organisation. The Divisional Coal Officer—to whom is attached a combustion engineer—is familiar with the requirements of individual firms in his Division, and they are, or should be, all aware that if they encounter supply difficulties of any sort, whether as regards quality or quantity, they can apply to him for assistance. As regards war industry, the Divisional Coal Officer is in close touch with the Regional Board of the Production Executive, on which are represented all the Supply Departments. By the use of this machinery, much has already been done to assist consumers either to obtain supplies of coal suited to their requirements, or to make efficient use of the supplies that are available. Supplies to public-utility undertakings are under continuous review by a Standing Committee representing the gas, electricity and water industries, which meets every week to discuss with the Department the allocation of the coal available. One of the considerations to which the Standing Committee attaches great importance is the allocation of the best coals to undertakings whose plant capacity is being taxed to the limit to meet the demands of essential industry, leaving the less suitable coals to be used by other undertakings having a margin of plant capacity.

The Select Committee also recommended that economy should be required of users of coal, gas and electricity. On this, the Department comments that a campaign has been intensified to teach fuel economy by lectures and all forms of propaganda. Economy is being imposed in all Government controlled establishments.

Conversions of Plant

The Board of Trade directs the attention of industrial fuel consumers to the urgent need for avoiding conversions of plant from one fuel to another (*e.g.*, from oil to coal, etc.), except on the advice of one of the Government departments. Such changes often involve diversion of labour and materials from more vital needs, and lead to unnecessary fuel supply difficulties.

If a change from one type of fuel to another, or the installation of new plant, is contemplated, the consumer should first consult the appropriate Government department. In the case of a consumer executing contracts for one of the Production Ministries, this Ministry should be consulted, and will in turn, when necessary, approach the Fuel Department of the Board of Trade responsible for the fuel to which the conversion is contemplated. A consumer not executing contracts for one of the Production Ministries should approach the appropriate Fuel Department of the Board of Trade direct. The consumer will then be directed in the light of available fuel and plant supplies.

Special considerations apply for creosote/pitch mixture and pitch. It has for some time been the policy of the Government that consumers previously using fuel oil or creosote should, in suitable cases, turn over to creosote/pitch mixture. Many consumers have already made, or are in process of making, this change, and those in the latter position are asked to complete the work by the earliest possible date. Further conversions may become necessary, but they should not be undertaken except on the advice of the Petroleum Department.

In certain parts of the country there are still substantial quantities of pitch available, and any fuel consumers wishing to consider its use should approach the Mines Department, Coal Tar Control, Quebec House, Leeds, 1.

THE FIRST 60-TON HEAVY COMBAT TANK built in the United States was delivered to the Army by the Baldwin Locomotive Works, Eddystone, Pa., in mid-December. The turrets are castings.

Production Minister's Duties

RESPONSIBILITY FOR WAR OUTPUT

In last week's issue, the appointment of Lord Beaverbrook as the newly-created Minister of Production was announced, and his duties summarised from the White Paper issued on the subject. Fuller details are now given here.

The Minister of Production will be the War Cabinet Minister charged with prime responsibility for all the business of war production in accordance with the policy of the Minister of Defence and the War Cabinet. He will carry out all the duties hitherto exercised by the Production Executive excepting only those relating to manpower and labour. These duties include the allocation of available resources of productive capacity and raw materials (including arrangements for their import), the settlement of priorities of production where necessary, and the supervision and guidance of the various departments and branches of departments concerned.

Subject to the general direction of the Minister of Production, all common services in the field of production will continue to be administered by the departments at present responsible for them. These common services include the controls administered by the Ministry of Supply and the Ministry of Aircraft Production, to which, however, the Minister of Production will have direct access, in accordance with agreed arrangements between the Ministers concerned. The allocation of industrial capacity (except shipyard capacity), machine tools, and all raw materials will be under the direct authority of the Minister of Production. All Regional Organisations and Capacity Clearing Centres which have been concerned in general production issues will be included in one group under the direction of the Minister of Production. This arrangement will not affect the direct relations between Departments of State and their Regional Officers.

The Minister of Labour and National Service will in future, under the general authority of the War Cabinet, discharge the functions hitherto performed by the Production Executive in regard to man-power and labour. These functions include the allocation of man-power resources to the Armed Forces and Civil Defence, to war production, and to civil industry, as well as general labour questions in the field of production. All labour questions between the Production Departments and the Ministry of Labour will be settled between the Minister of Labour and the Minister of Production, or such officers as they may appoint. The three Supply Departments will retain their existing separate labour organisations.

The Admiralty will continue to control the design, construction and armament of all naval vessels, and will also remain responsible for the construction, repair and defensive equipment of merchant vessels.

U.S. Brass Industry

The greatest production it has ever had will be achieved by the American brass industry in 1942, stated Herman W. Steinkraus, vice-president and general manager of Bridgeport Brass Company, in a year-end statement. Present capacities are operating 24 hours a day, six and seven days a week, and by the middle of 1942 at least five large new mills will go into production, with capacity for rolling strip brass for cartridge cases equal to current capacity of the industry.

Bethlehem's New 1,200-Ton Furnace

Bethlehem Steel Company, Bethlehem, Pa., lighted its new "H" blast furnace at the Lackawanna, N.Y., plant on November 22. It is reported by the company to be one of the world's largest blast furnaces, with a rated daily capacity of 1,200 tons. The height of the furnace is 105 ft.; hearth diameter, 27 ft.; thickness of plate forming the shell, 1 in.; thickness of lining at hearth jacket, 4 ft. 1½ in.; thickness of lining above mantle, 4 ft. 10½ in. Raw materials requirements, for normal operations, will be 2,160 tons iron ore, 384 tons limestone and 996 tons coke daily. The volume of air required will be 80,000 cub. ft. at 22 lbs. pressure per min.

Standardisation in House Building

After the last war there was a great shortage of houses and there was a great scramble for accommodation of any kind. Prices rocketed, and many people who through force of circumstances had to buy houses, had to do so at a price which crippled their finances for years afterwards. Many attempts were made to find a quick and easy method of building. All sorts of experimental houses were built and many so-called new ideas were brought into operation. It could not be said that results were on the whole satisfactory, and, after the first spate of the patent methods of building had exhausted itself, it was found that there were very few results to encourage people to do other than to go back to the old and tried traditional methods.

There is an additional difficulty to face in the post-war building programme which was not so apparent after the last war, in so far as the supply of materials available is hardly likely to be sufficient immediately to meet all needs. It would seem, therefore, according to MR. F. R. YERBURY, in a Paper on "Adaptation of Design to Standardisation and Mass Production," read before the Royal Society of Arts, that there is bound to be for some years after the war strict control of building and restrictions in the use of such materials as will be available.

Referring to wartime standardisation in building, the author points out that shortage of materials has done much to force the issue. Bricks have been standardised to two sizes and only these two types are being manufactured. Doors have been standardised, and there are now about six types which are available at the present time. The same thing has happened to many other articles too numerous to mention. This has resulted in great economy in material.

Metal windows are standardised, prefabricated and mass produced, at any rate as far as domestic requirements are concerned. Shortly after the last war the metal window manufacturers got together and agreed on standards and called in a panel of architects to produce acceptable designs. The result has been an enormous improvement in the fenestration of the average suburban house, and in much of the cheaper kind of speculative building which has been carried out on such a big scale since the last war. One feature which has prevented it from becoming completely unpleasant in appearance has been the standardised metal window.

The development of the idea of standardisation and prefabrication, of course, means mass production but there seems to be no reason why if windows, doors, staircases and so on can be brought on the site as completely finished articles, that it should not be possible to produce in a factory complete kitchen and bathroom units with plumbing and all other requirements provided for which could be brought to the site as one unit. Investigations are being made at the present time with a possibility of this being done, and the author thinks that before the war is over it will be possible to see these units actually manufactured.

SUPPLEMENTARY COUPONS FOR WORKERS' CLOTHING

The Board of Trade have now decided to award supplementary clothing coupons to certain types of iron and steel workers in sections of the industry not covered by their previous award. Awards are now announced to certain workers in non-ferrous metal industries, certain coke and by-products and gas workers, and certain other workers, including coal distributive workers. These coupons will be issued to employers for distribution to their workers, and individual workers must not apply. Employers in the trades concerned should get into touch with their nearest local office of the Ministry of Labour and National Service as soon as possible, and in any case not later than February 28, where full instructions for the distribution of the supplementary coupons to the workers entitled to them will be available.

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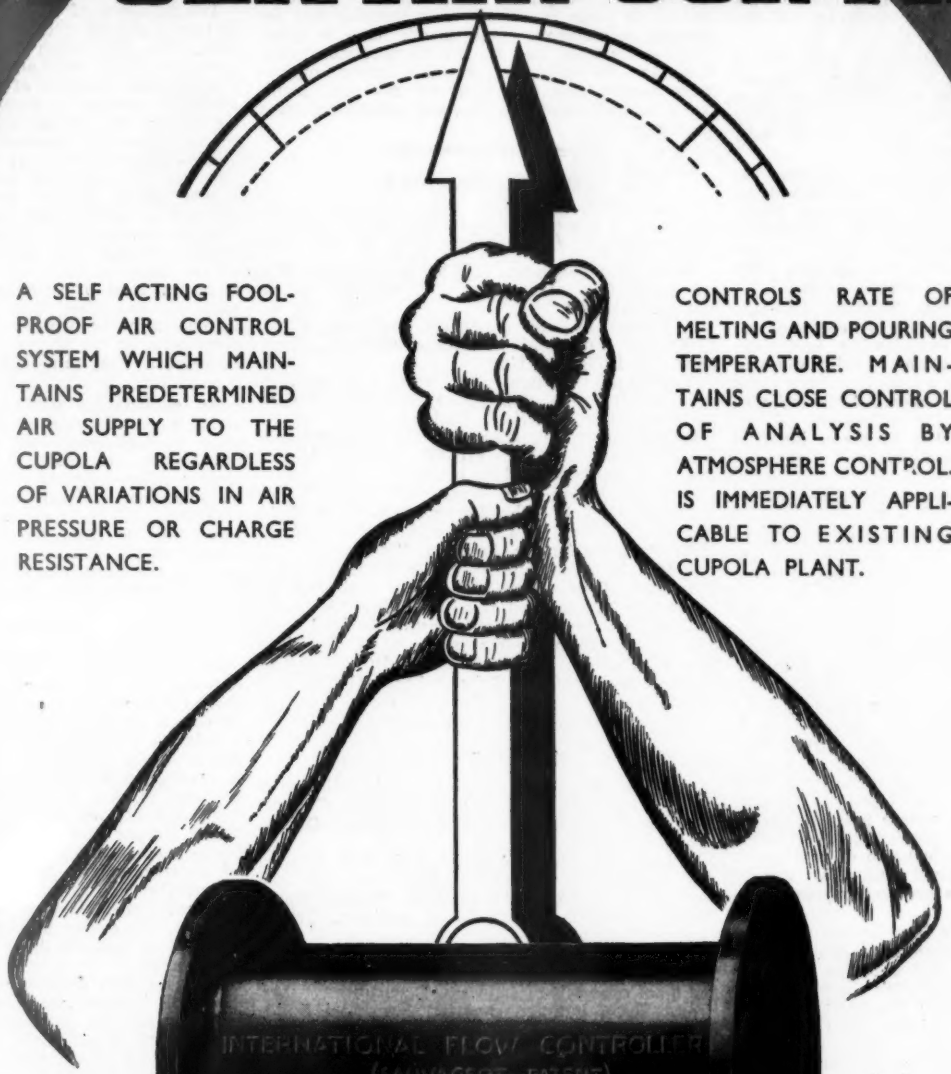

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The Week's News in Brief

Trade Talk

THE DIRECTOR-GENERAL OF ORDNANCE FACTORIES has decided to establish joint production consultative and advisory committees in all ordnance works. He is in course of meeting the trade unions with a view to agreement on the constitution of the committees.

WAGE INCREASES which came into operation in December gave £400,000 a week extra to a total of 2,100,000 persons in the engineering, shipping and other industries, according to the "Ministry of Labour Gazette." The figures do not take into account agricultural workers.

THE NUMBER OF MEN and boys registered at employment exchanges as wholly unemployed on January 12 was 100,215, an increase of 7,872 compared with December 8. Of this total 27,162 had been classified by interviewing panels as unsuitable for ordinary industrial employment. The increase was due mainly to severe weather.

J. BROCKHOUSE & COMPANY (IRELAND), LIMITED, spring manufacturers, are offering to holders of the 6 per cent. cumulative participating preference shares, 8,508 preference shares at 7s. 6d. a share in the proportion of two new shares for every three held. Ordinary holders are offered 4,852 ordinary shares at 2s. 6d. each in the proportion of one new for every three old. The £1 shares involved were formerly held by J. Brockhouse & Company, Limited, West Bromwich.

A BOOTLE FIRM is advancing £5,000 to finance its workers' total tax liability. The commercial manager of the firm explained that employees were now, when opportunities for overtime and big wages were restricted, called upon to pay income-tax on summer-time earnings, when there were exceptional opportunities for overtime. Calls upon current income proved to be out of all proportion to a man's weekly wage. The firm's scheme will permit payments to be spread over a longer period.

A PAPER on "The Industrial Development of the Lothians," read before the Royal Scottish Geographical Society, described the survey and development plans now being prepared as a basis for statutory schemes in East Lothian and Midlothian under the Town and Country Planning (Scotland) Act, 1932. The reserve potentialities of the Lothians and Fifeshire coalfields, taken in relation to the approaching exhaustion of coal seams elsewhere, suggested increased industrial activity and justified planning for a growing population in the Firth of Forth area.

NORTHUMBERLAND COUNTY COUNCIL has approved a decision of the joint committees dealing with the proposed Tyne tunnel and a bridge at Scotswood that the consulting engineer's report be submitted to the Ministry of War Transport, and that the Tyne Improvement Commission, the Coal Commission, the L.N.E.R. and other authorities interested be approached with a view to securing their agreement. The Council also approved a resolution that the Northumberland and Durham County Councils be recommended to prepare the plans, subject to the Ministry of War Transport agreeing to make a grant of not less than 75 per cent. of the approved cost.

THE DIRECTORS OF WM. BAIRD & COMPANY, Limited, propose a reduction in the rate of interest on the £611,485 debenture stock from 5 per cent. to 4 per cent. per annum. The stock will shortly become redeemable at the company's option. The company is a holding concern, and owns interests in Bairds & Dalmellington, Limited, Bairds & Scottish Steel, Limited, and other companies. Holders of £578,375 (94 per cent.) of the stock have signified their approval of the proposal to reduce the rate of interest. The trustees have also given their formal consent. The directors, accordingly, will carry the proposals into effect. A meeting was called for yesterday (February 18).

SOME OF THE WAR ORGANISATION in industry might well be continued in peacetime, said Sir Cecil M. Weir, Controller-General of Factory and Storage Premises, in the course of an address in Glasgow. The nation directed production now to those areas in which the elements of successful production—labour power, housing, and transport—could be obtained. By following a similar method, they could re-locate their industries in accordance with a national plan. Distressed areas should not be allowed to reappear; the diversification of industry should be widespread, and congestion and overcrowding eliminated for good. Enterprise would not be fettered by the licensing of production. On the other hand, it would secure that production was located where it was wanted, and not where the whim or the private inclination of a producer desired to place it. Thus, town-planning and industrial development could march hand in hand. That, in his view, was the key to successful reconstruction. Properly used, it would spread employment evenly, ease the strain on transport, facilitate a healthy housing policy, and unlock the doors to prosperity.

New Companies

("Limited" is understood. Figures indicate capital. Names are of directors unless otherwise stated. Information compiled by Jordan & Sons, 116, Chancery Lane, London, W.C.2.)

W. Pond & Company, 128, Steelhouse Lane, Birmingham—Tool makers, etc. £5,000. W., L. F., and W. F. Pond.

T. Darnell & Sons—Engineers, tool makers, etc. £3,000. A. Ford and W. Cumberland, 81, North Road, W. Bridgford, Notts.

E. Phillpott (Slough)—Engineers, tool makers, etc. £2,000. E. J. Phillpott, 5, Spring Lane, Cippenham, Bucks, and S. E. Taylor.

E.V.D. Engineering Company, 5-6, Clements Inn, Strand, London, W.C.2—£10,000. E. V., V. R., and H. C. Dodman, and R. Ilersic.

Surrey Precision Tool Works—£20,100. N. M. Maclean, M.P., L. J. Hydleman, R. S. Yates, T. L. Horabin, M.P., F. B. Coales, and N. G. Maclean, 1, St. Andrews Square, Surbiton, Surrey.

M.R.H. Minerals, Limited, Estate Office, Boothby, Brampton, Cumberland, has been registered to acquire certain mineral royalties (other than coal) and other properties in Northumberland and Cumberland formerly the property of the ninth Earl of Carlisle. The capital is £10,000. The directors are Mr. C. H. Roberts, Baron Henley, and Mr. S. Walton.

Contracts Open

Bromley, March 4—Castings during the year ending March 31, 1943, for the Borough Council. Mr. Harold Cliffe, engineer, Municipal Offices, Bromley, Kent.

Conway, March 2—About 700 ft. 9-in. internal dia. steel tubes with victaulic joints, for the Conway and Colwyn Bay Joint Water Supply Board. Mr. E. Oliver Jones, engineer, Trinity Square, Llandudno.

Dewsbury, March 9—Iron castings, steel reinforcements, etc., for 12 months from April 1, for the Corporation Highways Department. Mr. Ernest Shaw, borough engineer, Municipal Buildings, Halifax Road, Dewsbury, Yorks.

Maesteg, February 28—Iron castings for the year commencing April 1, for the Urban District Council. Mr. Evan Davies, surveyor, Council Offices, Maesteg, Glam.

Middlesbrough, February 23—Cast- and spun-iron pipes and specials, etc., during the year ending March 31, 1943, for the Tees Valley Water Board. Mr. E. A. Morris, clerk, Water Board Offices, Corporation Road, Middlesbrough.

Reports and Dividends

(Figures in brackets refer to the previous financial year.)

Barton & Sons—Interim dividend of 2½% on the ordinary shares.

Davies & Metcalfe—Final dividend of 6%, making 9% (10%).

Mather & Platt—Net profit, £156,066 (£159,703); final ordinary dividend of 6%, making 10% (same).

Spencer (Melksham)—Ordinary dividend of 4.8d. per share in respect of the year ended September 30, 1941.

Coventry Gauge & Tool Company—Dividend of 15%, tax free, including a 7½% bonus, for the year to August 31 last (same).

English Electric Company—Trading profit for 1941, after providing for taxation, £515,321 (£517,066); debenture interest, £47,217; depreciation, £100,000 (same); net profit, £362,604 (£363,736); preference dividend, £73,830; ordinary dividend of 10% (same), £192,251; general reserve, £100,000 (same); forward, £51,018 (£54,495).

Official Orders, etc.

The following official Orders have been issued by the Ministry of Supply and the Board of Trade during the past week, copies of which may be obtained from H.M. Stationery Office, or through any bookseller.

Control of High-Speed Steels

The Ministry of Supply has issued the Control of Iron and Steel (No. 19) Order, 1942 (S.R. & O., 1942, No. 19), which came into force on February 17, 1942, and amends the No. 15 Order. The principal purpose of the Order is to conserve available supplies of tungsten alloys by restricting high-speed steel containing tungsten to purposes where its use is essential. Under the Order: (1) High-speed steel whatever the tungsten content can now only be acquired under the authority of a licence issued by the Iron and Steel Control; hitherto a licence was necessary only when the tungsten content was 14 per cent. or more. (2) Existing licences for high-speed steel containing 14 per cent. or more of tungsten will remain in force for steel of such specification until May 1 next; on and after that date such licences will automatically be valid only for high-speed steel containing up to 6½ per cent. of tungsten. (3) High-speed steel cannot now be acquired without licence from a stockholding merchant.

An explanatory memorandum has been issued giving guidance to makers of small tools and other users of high-speed steel in connection with the introduction and treatment of "substitute steels" to replace high-tungsten high-speed steels. The memorandum and any additional information or assistance can be obtained from suppliers of high-speed steel or from the Director for Alloy and Special Steels, Ministry of Supply, Ashorne Hill, or from the Controller of Jigs, Tools and Gauges, 35, Old Queen Street, London, S.W.1.

Machine Tools

The Control of Machine Tools (Cutting Tools) (No. 1) Order, 1942, made by the Board of Trade, requires that any person who carries on in the United Kingdom any undertaking involving the use of certain cutting tools and who, on January 31, had in his possession or control any such tools in excess of the number he might reasonably expect to require for the maintenance of his production up to April 30, shall furnish to the Controller of Jigs, Tools and Gauges, Machine Tool Control, 35, Old Queen Street, London, S.W.1, certain particulars. These must state the number of such tools in excess of his requirements that he has in his possession, the number he has on order, and the number that he might reasonably be expected to require up to July 31. A dealer in the tools specified is also required to indicate the number in his possession on January 31 in excess of the number sold by him in the four months ending on the same date. The tools involved are twist drills, reamers, milling cutters, taps, dies, cemented carbide or hard metal tipped tools, form tools, lathe and planer tools, and saws of certain kinds and sizes. The Order is designated S.R. & O., 1942, No. 77.

A section of the Machine Tool Control of the Ministry of Supply has now been formed to deal with all problems relating to used machine tools. Since August, 1940, George Cohen, Sons & Company, Limited, have been acting as agents to the Control, which now takes over the organisation built up by George Cohen. Letters and inquiries should be addressed to Caxton House (West Block), Tothill Street, London, S.W.1.

Export Licences

Licences will, in future, be required to export gas meters manufactured wholly or mainly of iron and steel. Licences will also be required to export certain articles made wholly or mainly of non-precious metals, such as stands, frames and holders, dressing table trays, vases, candlesticks, etc.; and for the following: Plates and grids for lead-acid accumulators; instruments for indicating, measuring, recording or testing electrical properties or quantities; pyrometers; fittings, wholly or mainly of metal, of a kind used for street or interior lighting; iron and steel conduit fittings for electrical wiring, and wiring accessories and fittings, wholly or mainly of metal, of a kind commonly used for domestic purposes. Applications for licences to export these articles will not, normally, be entertained. The Order is designated S.R. & O., 1942, No. 172.

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Raw Material Markets

New developments in the war situation must inevitably mean that production of armaments, etc., will be still further increased, if that is at all possible, so that pressure for supplies of iron and steel will become heavier. Producing works have been called upon to play a very important part in the national effort for a long time past, and the response in many respects has been a revelation even to those closely associated with the industry, and if demands expand further, iron and steel makers can be relied upon to do all in their power to meet the wishes of Government departments. Results so far achieved in iron and steel outputs have enabled deliveries to essential consumers to be made on a generous scale. This has only been accomplished through the most efficient utilisation of available resources, and at times, it must be admitted, difficulties of appreciable magnitude had had to be surmounted. In particular, the acquisition of foreign ores has presented problems, and output of hematite has suffered, but enough has been forthcoming to meet really urgent demands. Steelmakers' chief responsibility at the present time is to meet the rapidly increasing requirements of special alloy qualities, which are needed for the manufacture of munitions, etc.

Pig-Iron

MIDDLESBROUGH—Light-castings foundries in the Cleveland district are not particularly active, their order-books containing few Government specifications, while restrictions on ordinary domestic work and on the export trade are so far reaching that comparatively small outputs are sufficient to cope with current business. Consequently, consumption of high-phosphorus iron among these concerns is limited and, although local production of this type of iron has been suspended for a long time past, adequate tonnages are arriving from the Midlands. Ironworks on the North-East Coast readily dispose of all the basic, hematite, refined iron and ferro-manganese that they can produce. Medium-phosphorus and refined irons are used extensively to make up for the deficiency in hematite production. In instances where the need cannot be met by the use of alternative descriptions, hematite is being delivered fully and promptly, but the Control authorities are only permitting minimum tonnages to be absorbed.

LANCASHIRE—There is quite a brisk demand for special refined grades of pig-iron from Lancashire consumers, and this is readily satisfied by Midland producers. It is reported that contract tonnages are being demanded, while there is also a fair amount of new business available. Moderate tonnages of forge pig-iron are required also. Ordinary grades of iron are reasonably well taken up, but there is no pressure in this section, and Derbyshire and Staffordshire makers are easily able to cope with current needs. Speciality engineers are able to operate at capacity levels, but the same cannot be said of a number of light-castings makers and jobbing foundries, who are urgently in need of increased support.

MIDLANDS—General engineering foundries producing heavy castings are well supplied with orders from Government departments and other bodies placing business in connection with war materials, and they are getting sufficient quantities of pig-iron to satisfy their immediate requirements. Business in this section of the industry will inevitably remain very active, but there is slight prospect of there being any appreciable improvement in the light-foundry trade, which has been in a depressed condition since the outbreak of hostilities. Hematite supplies remain short, but supplies of other types of iron are generally coming forward satisfactorily. High-phosphorus iron is especially plentiful, despite the fact that its use by heavy engineers has been stepped up owing to the shortage of hematite. At the same time, though, consumption of high-phosphorus iron in the light-foundry trade, which in normal times is the chief user, has declined.

SCOTLAND—Foundries using high-phosphorus iron from the English Midlands have experienced some inconvenience of late, due to interrupted deliveries brought about by the severe weather last month, but there has been an improvement since. The requirements of the light-castings industry are easily satisfied, as this department is finding considerable difficulty in securing orders. Conditions in heavy engineering circles, on the other hand, are as brisk as ever, with every prospect of business remaining active over a long period ahead. Foundries catering for the requirements of shipbuilders, etc., have as much work on hand as they can accommodate, and replacement orders are regularly offered. Steelmaking irons are in insistent request.

Coke

Delays in the arrival of foundry coke at the consuming points are still reported, but the position has eased and it is hoped that further improvement will be witnessed in the near future. Only consumers relying on weekly deliveries have been seriously affected by the interruptions, and these are in the minority. Ovens are in possession of considerable tonnages, transport having been solely responsible for the irregular arrival of fresh supplies. The minimum price of Durham best foundry coke, delivered Birmingham and Black Country stations, remains at 62s. 9d. per ton.

Steel

The demand for special alloy steels is so great that it is still necessary for purchases to be made abroad; at the same time, the expansion in our own production has been highly pleasing, output having been materially enlarged in a comparatively short space of time. These qualities of steel are being absorbed in various war factories on a vast scale, and it is certain that consumption will rise steadily with the coming into operation of additional producing units. Thus, there is every need for attaining the maximum output of special alloy steels. Most other sections of the steel industry are also busy, especially those connected with shipbuilding, wagon, boiler and other heavy trades.

Scrap

Generally speaking, scrap merchants are able to cover consumers' requirements, but there is little, or no, margin, so that it is necessary to search for and sort all available supplies. There are many indications that this is being done extensively, but the authorities cannot afford to neglect any opportunity of acquiring additional tonnages. Deliveries were somewhat disorganised recently, but there has already been a welcome improvement. Steelworks are pressing for all the heavy mild-steel scrap cut to furnace sizes they can get and even larger tonnages are required if steel production is to be expanded in accord with the demands of the times. Other grades used at the steel furnaces are also in strong request, while foundrymen are in the market for big tonnages, and some difficulty is experienced at times in acquiring heavy cast-iron scrap and first-class machinery metal.

Metals

COPPER—The rising consumption of copper does not appear to have created any difficulties so far as essential users are concerned, but the Control, of course, adheres rigidly to its policy of curtailing deliveries to ordinary domestic users. Supplies of the red metal from the Empire and the Belgian Congo have arrived in the United Kingdom satisfactorily, but there is an urgent need to conserve shipping space and easier supply conditions so far as non-war use of the metal is concerned are unlikely to eventuate so long as hostilities continue.

The American Copper Institute announces that U.S. copper statistics for January compare with December as follows (in tons):—Crude production, 88,319 (86,961); refined production, 90,017 (89,940); deliveries to U.S. consumers, 130,467 (137,368), of which Latin America copper totalled 46,257 (50,640); export shipments, nil (nil); refined stocks at end of month, 81,371 (75,564).

TIN—In addition to the basis price of £275 a ton for tin, delivered buyers' premises, the following extra prices and charges, if any, for grades, sizes of ingots, bars or strip, grain bars, granulated and small lots, have now been established by the Non-Ferrous Metals Control, Ministry of Supply. They apply to all metal sold by the Control since the date of the Control of Tin (No. 3) Order, 1941, and are as follow:—Grades.—Minimum 99 per cent. to under 99.75 per cent. at the basis price of £275; minimum 99.75 per cent. to under 99.9 per cent. 30s. a ton extra; minimum 99.9 per cent., 70s. a ton extra. Sizes of ingots.—99 per cent. tin, extra for ingots under 28 lbs., £1 10s. a ton; 99.75 per cent. tin, extra for 28-lb. ingots, 10s. a ton; extra for under 28-lb. ingots, £1 10s. a ton. Bars or strip.—1-cwt. drums, £5 a ton extra; 2/3-cwt. drums, £4 a ton extra; 4/5-cwt. drums, £3 a ton extra; 1-cwt. bags, £2 a ton extra; ½-cwt. bags, £2 a ton extra. Grain bars, £20 a ton extra; granulated, £25 a ton extra. Small lots.—Over 10 cwts. and under 1 ton, £1 a ton extra; over 5 cwts. up to and including 10 cwts., £2 a ton extra; over 1 cwt. up to and including 5 cwts., £4 a ton extra; 1 cwt. and under, £8 a ton extra. The provisional basis price of £275 a ton which has so far been charged on all contracts and invoices therefore will be altered accordingly, and amended invoices will be forwarded in due course.

It will be recalled that under the Control of Tin (No. 3) Order, 1941, acquisition of tin was made subject to licence or direction by the Minister; the definition of tin in that Order embraced ores, concentrates, residues, etc., as well as defined forms of metallic unwrought tin and tin scrap. The Control of Tin (No. 4) Order, 1942, which came into operation on Monday, brings the tin content of alloy scrap containing not less than 12 per cent. of tin and of tinplate clippings and waste within the definition. Persons who acquire not more than 1 cwt. of tin in any calendar month, and persons who do not treat, use or consume tin scrap, alloy scrap as above-mentioned, tinplate waste, or tin residue, slag, dross or sludge otherwise than by cleaning, crushing or sorting it, are exempted from the licensing provisions regarding these materials.

While Japanese successes have gained control for the Axis powers of a big proportion of the world's tin-mining output, difficulties in smelting the ores will be inevitably great if the Allied authorities have pursued the "scorched-earth" policy to the maximum extent. Transport of ores to active smelters nearer Japan will not be at all easy, so long as hostilities are being waged. The American authorities have decided to increase the capacity of the new Texas tin smelter to 36,000 tons. It was originally fixed at 18,000 tons and later increased to 25,000 tons.

SPELTER—Less of this metal is now being used for galvanising, in view of the heavier demands from the brassworks and die-casting establishments. For essential purposes adequate supplies are being despatched, but the control over the metal has been tightened appreciably as a precautionary measure. It is reported that the American Office of Production Management anticipate that the supply of zinc during the current year will be in the region of 978,000 tons; demands for the metal are substantial in connection with defence, and many uses are being either eliminated altogether, or drastically curtailed.

LEAD—While a large amount of lead is being consumed by war factories, supplies remain satisfactory, and restrictions imposed upon the use of the metal are made with an eye on possible eventualities.

Swedish Industry and Fuel Supplies

The Swedish Minister of Supply recently drew attention to the importance to Swedish industry of uninterrupted imports of raw materials and the dire effect of the war blockade on supplies. The heavily decreased imports of coal and coke have affected industrial activities. A relatively strict rationing of coal and coke was resorted to, but not until the spring of 1941 was it necessary to cut these rations drastically. In May last the total industrial coal consumption was reduced to about one-third of the 1939 average, and during the summer months it was reduced further. However, the supply of substitute fuels has been large enough to meet the demands of industry. The cement industry, a large consumer of coal, has suffered severely from the fuel shortage. During the first half of 1941 iron and steel production was lower than during the same period of 1940, but exceeded the output for the 1939 period. Production of iron and steel has not been sufficient to meet 1941 requirements. A shortage of pig-iron and wrought-iron scrap is expected. Production of iron and steel during the last half of 1941 is expected to be reduced, while the outlook for production of quality steel is brighter. The blockade has shut Sweden off from many important export markets. As a result of this, the demand of the domestic market may be met.